To: Deb Neimeier, Ph.D. and Keith Lawton

From: Sorin Garber
Cross-Cascades Corridor Analysis Project Team

Date: May 18, 2001

Subject: Cross-Cascades Corridor Spatial Input/Output Model Development -- Background Material for 6/1/01 Peer Review Panel Meeting, Seattle, WA

On behalf of the Washington State Department of Transportation, its MPO partners, and the HDR consulting team, thank you for participating in our technical study.

As promised, we are providing here a summary description of the study, and our expectations for the Peer Review session. To get you up to speed, we are also identifying here: 1) our work efforts to date; 2) the reference sources we're utilizing; 3) summaries of our analyses; and 4) a discussion of our analytical methodology. We expect that these materials will provide the proper context for our meeting on June 1, 2001.

This memorandum concludes with a list of Panel members' responsibilities, and the structure/protocol we will utilize to help us achieve maximum value from the Panel. Finally, you'll note the initial questions we intend to pose to each of you at our meeting.

Please contact either me (503-768-3700; sgarber@hdrinc.com), Mark Ford (503-768-3779; mford@hdrinc.com) or Doug Hunt (403-286-7206; jdhunt@ucalgary.ca) with any questions, suggestions or comments.

Project Description:

This project is being completed for the Washington State Department of Transportation (WSDOT), Transportation Planning Office. Charlie Howard is the Director of the Office, and Todd Carlson is the Regional Planning Manager. WSDOT's Project Manager is Nancy Boyd, and she works in the Planning Methods unit, which is run by Faris Al-Memar.

WSDOT contracted with HDR, Inc., to develop a transportation planning model that is capable of producing interregional forecasts and analyses across the full length of the Cross-Cascades Corridor, incorporating all transportation modes and able to test alternative scenarios for transportation development. Further, the model must be able to be used by WSDOT staff for analyzing other corridors.

The modeling approach selected is known generically as a Spatial Input-Output Model. It distributes household and economic activity across zones, uses links and nodes of a transportation network to connect the zones and model the transportation system and then calculates transportation flows on the network. It uses an input-output (I-O) structure of

Cross-Cascades Corridor Routes
(I-90, SR-2 & BNSF rail lines)

the economy to simulate economic transactions that generate transportation activity. In future years the spatial allocation of economic activity, and thus trip flows, is influenced by the attributes of the transport network in previous years. Thus, the model is dynamic both with respect to land use and transportation.

The spatial I-O approach was selected from among several modeling options presented to the project team. Other options included a four-step traffic model, trip tables calculated through an entropy maximization method, micro simulation and linear programming. Micro simulation and linear programming were not chosen because they would not be able to address the issues present in the corridor within the resources available. The spatial I-O approach was determined to be superior to the other two approaches because of its ability to address more policy issues, particularly those associated with distribution of economic activity.

In selecting the spatial I-O approach the project team recognized that it would have to be developed on a very fast track and that some desirable elements of the model would have to be skipped in this first round of development. Further, it was recognized that the model could not be fully tested within the available time frame. As a result of these decisions it is recognized that the model in its present form will demonstrate the value of the approach and provide a tool that can be further developed in later corridor and statewide transportation studies.

The model will aid WSDOT in its transportation planning efforts and enable WSDOT to better tailor its services to meet transportation needs of the state. The model provides WSDOT with a tool for estimating not only the issues within this corridor, but also forms the basis for a statewide travel demand model. It incorporates economic and demographic variables and has the potential to incorporate land use directly in future updates of the model.

The purpose of this report is to document model development and to allow WSDOT staff to run their own scenarios and revise the model for use in other corridors. This summary overview is intended to introduce the reader to the model framework as implemented for Cross Cascades, identify key data sources and assumptions, and document suggestions for future improvements.

Consultant Team:

HDR, Inc., is leading the consultant team for the study with support on model development from Hunt Analytics, Inc., and for corridor planning from Transystems Corporation. The task leaders for the consultant team are as follows:

Sorin Garber	HDR	Project Manager
Mark Ford	HDR	Deputy PM/Economist
Tara Weidner	HDR	Model Development
Jolyon Rivoir-Pruszinski	HDR	GIS/Model Development
J. Douglas (Doug) Hunt, PhD	Hunt Analytics	Leader --Model Development
John Abraham	Hunt Analytics	Model Development
Rob Bernstein	Transystems	Corridor Planning
Courtney Knox	Berk Associates	Documentation

Guiding Principles for Forecasting Tool:

At the start of our project, WSDOT provided the following list of guiding principles for the forecasting tool development assignment. While the list of principles may now be expanding, it's useful to understand the initial objectives we have been attempting to achieve.

- It must be capable of analyzing and estimating demand for highway, rail, and air modes.
- It must be capable of producing interregional forecasts and analyses across the full length of the corridor.
- It must have the capability to directly integrate output from other forecast models in use along the corridor.
- The forecast model developed for the Cross Cascades Corridor must be applicable and transferable to other corridors, and be "expandable" for eventual use in analyzing the entire state highway system, as well as other transportation facilities and services of statewide significance (as specified in RCW 46.06.140).
- It must be capable of providing 6-year and 20-year forecasts.
- It must utilize the WTP policy framework as the principal criterion and scenarios for analysis, with an emphasis on highway congestion relief.
- It must be capable of producing output in GIS or other "visually-friendly" and meaningful format.
- It must be simple to operate, modify and update by WSDOT staff (i.e., consolidate off-the-shelf tools into one "package").

Another important objective for this task is that the development and testing of this forecast model be completed within a sixteen (16) week period in order for it to be available for use in subsequent project elements.

Evolution of the Cross-Cascades Corridor Model Development:
The model development effort was initiated on January 19, 2001 in a daylong technical workshop of WSDOT and MPO modelers in the Cross-Cascades (i.e., I-90, SR2, and BNSF east-west rail lines) and the I-5 corridors. At that workshop (see Minutes of 1/19/01 Technical Workshop), a series of approaches to building the interregional model were discussed and evaluated. The outcome of that workshop was the selection of the spatial input-output approach using the MEPLAN software package. On February 2, 2001, another day-long technical workshop was held to review the consultant's team work plan, which included the use of IMPLAN for economic inputs, two additional technical workshops, an interim forecast model for use in corridor planning in twelve weeks, and *a calibrated multi-modal forecast model in 16 weeks, i.e., by June 1st* (see attached Minutes of 2/2/01 Technical Workshop).

A third technical workshop was held on March 16, 2001 to review the progress in model development and discuss the approach, data sources, and assumptions used for model specification, zones, and networks. In addition, the meeting was intended to identify potential future model upgrades that could be coded into the next generation of the model development process. Finally, a fourth workshop was held on May 4, 2001 to review the operating model.

Objectives for the Peer Review Panel:
The objective for the Peer Review Panel is to provide an independent critical assessment of the approach, methodology, data and assumptions being advanced by the consultant team for its development of the Cross-Cascades Forecasting Model, as described in four questions following this section.

Each of you will be asked to review the four questions and corresponding issues at a daylong session. Members of the consultant team will make a presentation of the team's approach, methodology and preliminary findings, and other team members will facilitate the session. At the conclusion of the session, the two of you will be responsible for preparing a brief document summarizing any concerns and recommendations for the final analysis, and if necessary, a description of technical areas where you may not have reached consensus among yourselves. This document will guide the consultant team toward a more supportable analysis.

Peer Review Panel’s Responsibilities:
- Become familiar with the study’s objectives. Disclose any potential conflicts with similar work being completed by others for WSDOT, Washington State MPOs, academic institutions, non-profit and/or for-profit institutions, due to relationships with these organizations and their analysts.
- Become acquainted with the intent of the analysis through review of materials provided by the consultant team.
- Review the set of questions and background materials prepared for the 6/1/01 meeting at PSRC's offices at 1011 Western Avenue, Seattle, WA.
- Attend and actively participate at the meeting of the client staff and consultant team Panel; focusing on the set of questions enclosed here.

- Conclude the Panel review meeting by preparing a joint statement confirming the Peer Review Panel results, including any issues for which there may have been disagreement.

Protocol:

- Management of the Peer Review Panel's activities – including delivery of relevant documents, preparation of relevant agendas, scheduling and follow-up of meetings, and documentation of Panel's assessments, etc. – will be the responsibility of Sorin Garber.
- Mark Ford will conduct facilitation of the Peer Review Panel's discussions.
- A presentation of the team's background work and preliminary findings will be made to the Panel by Doug Hunt, John Abraham and Tara Weidner before the session begins in order to focus on the questions that were prepared in advance of the meeting.
- Client staff and consultant team members will be available to answer questions about composition of the analysis and the baseline data and other variables selected.
- After Panel members formally respond to the questions prepared for them, client staff and consultant team members will directly engage in discussions about conclusions reached by the Panel.
- Panel members, client staff and consultant team staff will exercise professional courtesy and conduct throughout the session.

Question 1: Please comment on the model structure used in the CCC Project. How will the model assumptions impact reasonableness of outcomes and future model usage?

- Spatial I/O vs. other model approaches
- Static Data: Network Zones/Networks
- Behavioral Data: Behavioral/Operational Assumptions (economic, trip rates)
- Data Sources (inputs and targets)

Question 2: Please comment on initial model outputs for base year and no-build future years

Question 3: Future scenarios to be evaluated with this model by WSDOT.

Question 4: Please identify a prioritized list of the next steps that should be taken with this model? Does your answer/priority change if the next application is the I-5 Corridor?

- Changes to model structure
- Changes to data sources/targets
- Changes to economic/operational assumptions
- Other

Washington Department of Transportation
Cross-Cascades Corridor Study:
Model Development Documentation

Summary

Prepared for discussion at June 1 Peer Review:
WSDOT, Planning Department

Prepared by:
HDR Engineering, Inc.
in association with
Hunt Analytics, Inc.
Transystems

June 2001

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Washington Department of Transportation
Cross-Cascades Corridor Study:
Model Development Documentation

Background and Purpose

The Washington State Department of Transportation (WSDOT) contracted with HDR, Inc., to develop a transportation planning model that is capable of producing interregional forecasts and analyses across the full length of the Cascade Corridor, shown in Figure 1, incorporating all transportation modes and able to test alternative scenarios for transportation development. Further, the model must be able to be used by WSDOT staff for analyzing other corridors.

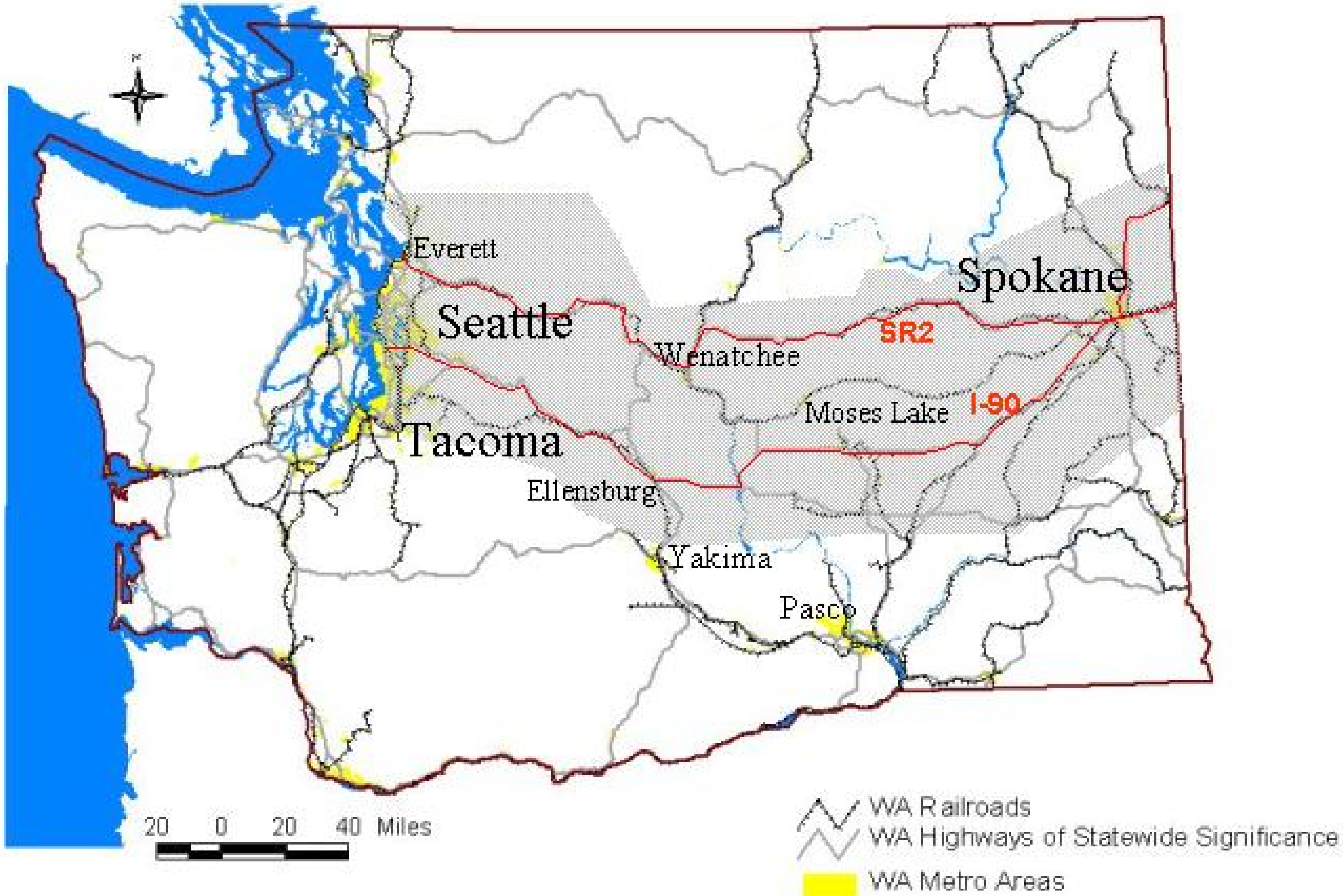
The modeling approach selected is known generically as a Spatial Input-Output Model. It distributes household and economic activity across zones, uses links and nodes of a transportation network to connect the zones and model the transportation system and then calculates transportation flows on the network. It uses an input-output (I-O) structure of the economy to simulate economic transactions that generate transportation activity. In future years the spatial allocation of economic activity, and thus trip flows, is influenced by the attributes of the transport network in previous years. Thus the model is dynamic both with respect to land use and transportation.

The Spatial I-O approach was selected from among several modeling options presented to the project team. Other options included a four-step traffic model, trip tables calculated through an entropy maximization method, microsimulation and linear programming. Micro simulation and linear programming were not chosen because they would not be able to address the issues present in the corridor within the time frame available. The spatial I-O approach was determined to be superior to the other two approaches because of its ability to address more policy issues, particularly those associated with distribution of economic activity.

In selecting the spatial I-O approach the project team recognized that it would have to be developed on a very fast track and that some desirable elements of the model would have to be skipped in the first round. Further, it was recognized that the model could not be fully tested within the available time frame. As a result of these decisions it is recognized that the model in its present form will demonstrate the value of the approach and provide a tool that can be further developed in later corridor and statewide transportation studies.

The model will aid WSDOT in its transportation planning efforts and enable WSDOT to better tailor its services to meet transportation needs of the state. The model provides WSDOT with a tool for estimating not only the issues within this corridor, but also forms the basis for a statewide travel demand model. It incorporates economic and demographic variables and has the potential to incorporate land use directly in future updates of the model.

Figure 1 - Cross Cascade Corridor



The purpose of this report is to document model development and to allow WSDOT staff to run their own scenarios and revise the model for use in other corridors. This summary overview is intended to introduce the reader to the model framework as implemented for Cross Cascades, identify key data sources and assumptions, and document suggestions for future improvements.

Model Overview

An overview of the model is shown in Figure 2, referred to as "The Hunt Diagram." The model has three major components:

- Land Use, which describes economic, household and land use characteristics and the interaction between them. Key elements of the land use component are:
  - The I-O table (1.1), which estimates the amount of activity generated throughout the Washington economy as a result of output of each economic sector, and
  - The estimate of "exogenous demand" (1.2), which is the amount of export activity and other activities, not tied to economic production in any sector.
  - This initial version of the model does not contain land prices, which reflect the impact of growth on production costs and household costs. Land prices may be added to future updates of the model.
- Transport, which describes the transportation network in terms of:
  - The transport flows associated with economic activities (2.1)
  - The network (2.3) which describes how trips travel through the network, influenced by cost and capacity constraints, and
  - The links (2.4) that describes how each mode connects to other modes.

- The Interface Model, (3.1 and 3.2) which relate economic and household activities to transportation flows and create the interactive capabilities of the model:
  - Relating economic and household activities to transport flows, and
  - Relating transportation costs and accessibility to economic and household activity.

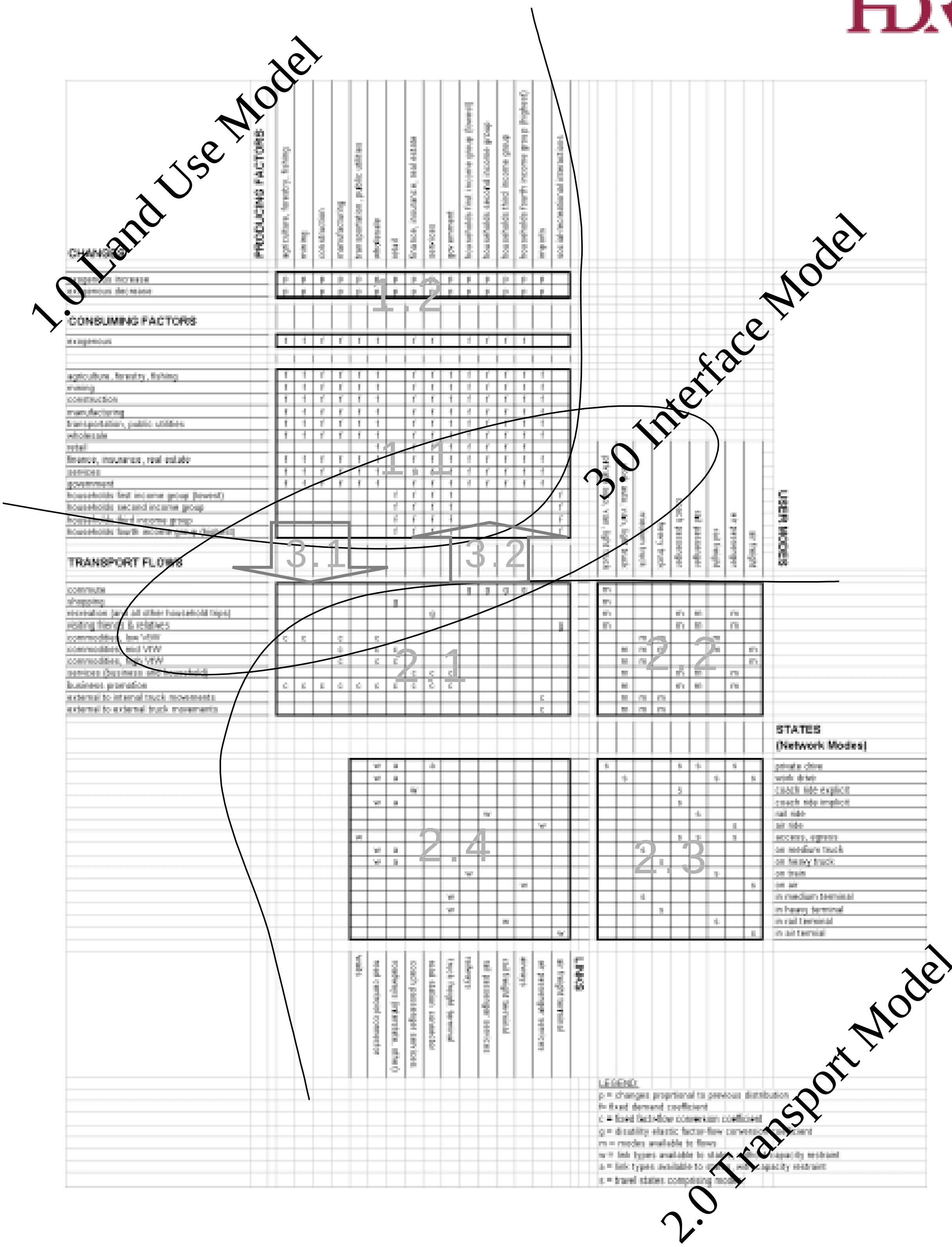


Figure 2 - The Hunt Diagram

MEPLAN

The software used to run the model is MEPLAN, developed and distributed by ME&P of Cambridge, UK. The structure of the MEPLAN model is shown in Figure 3. The structure parallels the Hunt Diagram with:

- The *Land Use Model* (LASA and LASB) processing economic and household data, including the input-output table and generating output data.
- The *Transport Assignment Model* (TASA and TASB) which contains transportation network and flow information; and
- The *Interface Model* (FREDA) which relates land use and economic volumes.

Throughout the diagram the following definitions apply to the three letter codes:

- U= user input (three letter codes starting with other letters are model outputs;
- L= land use
- T= transport
- F= flows between economy and transport

The components labeled with four letters (LUSB, LUSA, FREDA, TASA and TASB) are the processing components of the model (the “black boxes”).

Key outputs generated by MEPLAN include:

- Land use and economic outputs, in terms of zonal characteristics (employment and households);
- Transport volumes including O-D transport flow volumes, network link volumes, congested travel times, network data and other statistics; and
- Interface model including disutilities (costs) of transportation between zone pairs, flow volumes and evaluation statistics.

It must be noted that the MEPLAN model is intended to model availability and demand for land, including changes in land prices. That component was not included in this initial version of the Cross Cascades model development because of the cost of collecting the data and the limited time available for development of the model. It could be included in future updates.

Outputs of the Cross Cascades Model will include:

- Average Daily Traffic for the average weekday for the corridor;
- Mode splits between highway, rail, intercity bus and air for the corridor;
- Future household allocation by income group and zone; and
- Future employment allocation by industry and zone; and

Because of the interactive nature of the model it can be used to test:

- Impact of economic and demographic changes on transport;
- Impact of transport improvements on the economy and population;
- Impact of policy decisions that change the availability or cost of transportation.

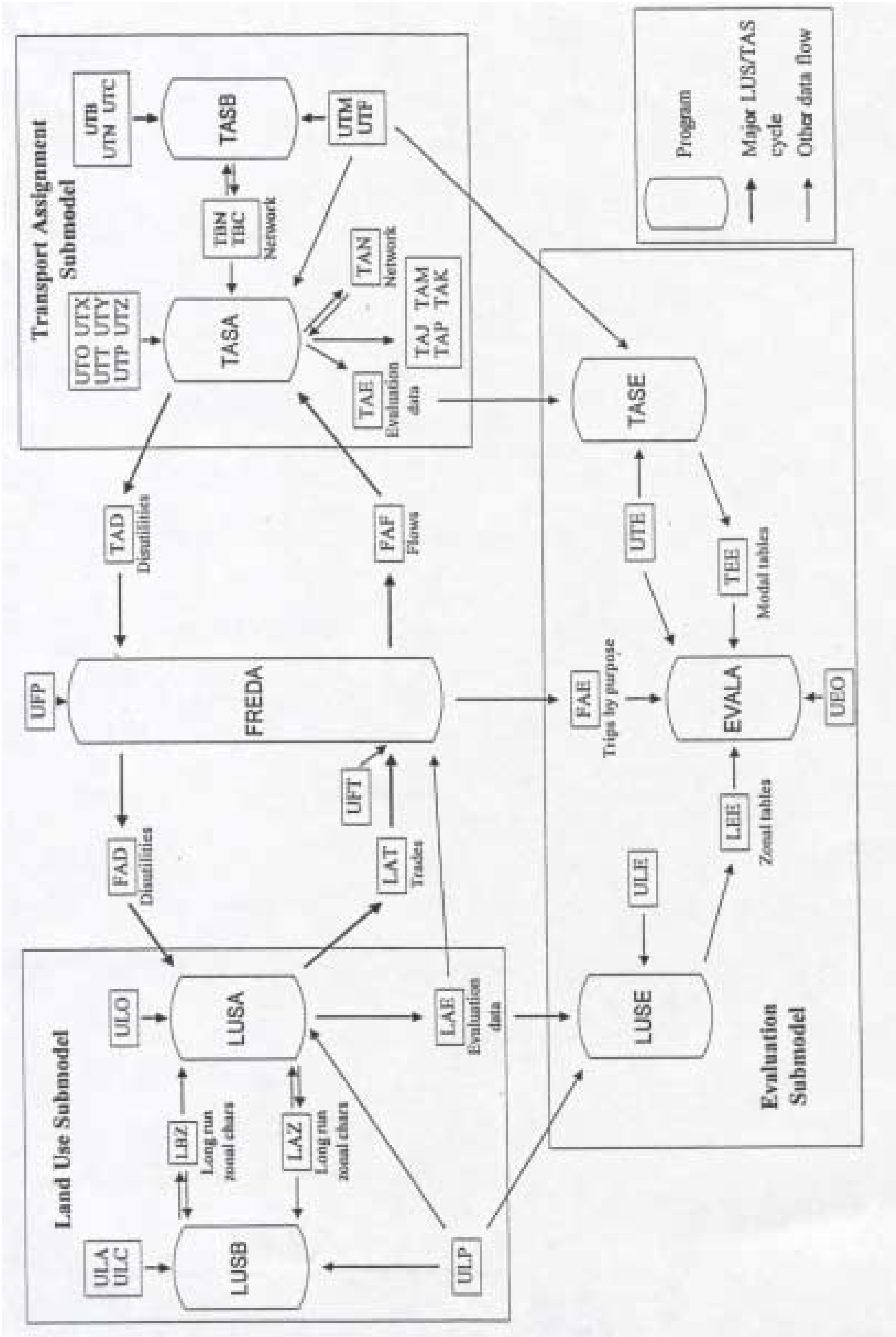


Figure 3 - MEPLAN Flow Diagram

The remainder of this summary describes the three basic components of the model in more detail as applied in this study of the Cross Cascades Corridor. The report is organized by the Hunt Diagram and contains references to the MEPLAN model components.

1. Land Use Model

1.1 Consuming and Producing Factors (Economic Activity) Table

Factor Definitions

Factors are defined (in ULP [1]) as the chosen set of industry sectors and household income groups. Ten industry sectors were used in the Cross Cascade Model (CCM) based on the major industrial for reporting of employment data by the Labor Market and Employment Analysis (LMEA) unit of Washington's Employment Security Department:

- Agriculture, forestry and fishing
- Mining
- Construction
- Manufacturing
- Transport, Communications and Public Utilities (TCPU)
- Wholesale Trade
- Retail Trade
- Finance Insurance and Real Estate (FIRE)
- Services
- Government

Input-output coefficients relating consumption and production were taken from the IMPLAN I-O model for Washington State. A number of assumptions had to be made to adjust the IMPLAN balanced I-O table for use the MEPLAN model structure. The most significant of these were:

- Demarginalizing retail trade so households consume from retail via wholesale, rather than directly form each industry;
- Reducing the number of export, household income, financial processing and government categories; and
- Converting the trade flows from dollars to employees or households based on productivity factors.

Future models could use more detailed economic sectors based on available input-output and employment data.

Households were broken into four roughly equal income groups:

- $0 - 17,499 (26% of 1990 WA Households)
- $17,500 - 29,999 (22%)
- $30,000 - 49,999 (28%)
- greater than $50,000 (24%)

All data were from 1998 or adjusted to that year to provide a consistent base year.

Zones

The CCM uses 61 zones, 54 in Washington, 1 in Idaho, and 6 external. Washington and Idaho zones, shown in Figure 4, were based on counties. Seven counties within the corridor were further subdivided into 2 to 4 zones. These included:

- Adams
- Chelan
- Douglas
- Grant
- King
- Kittitas
- Lincoln

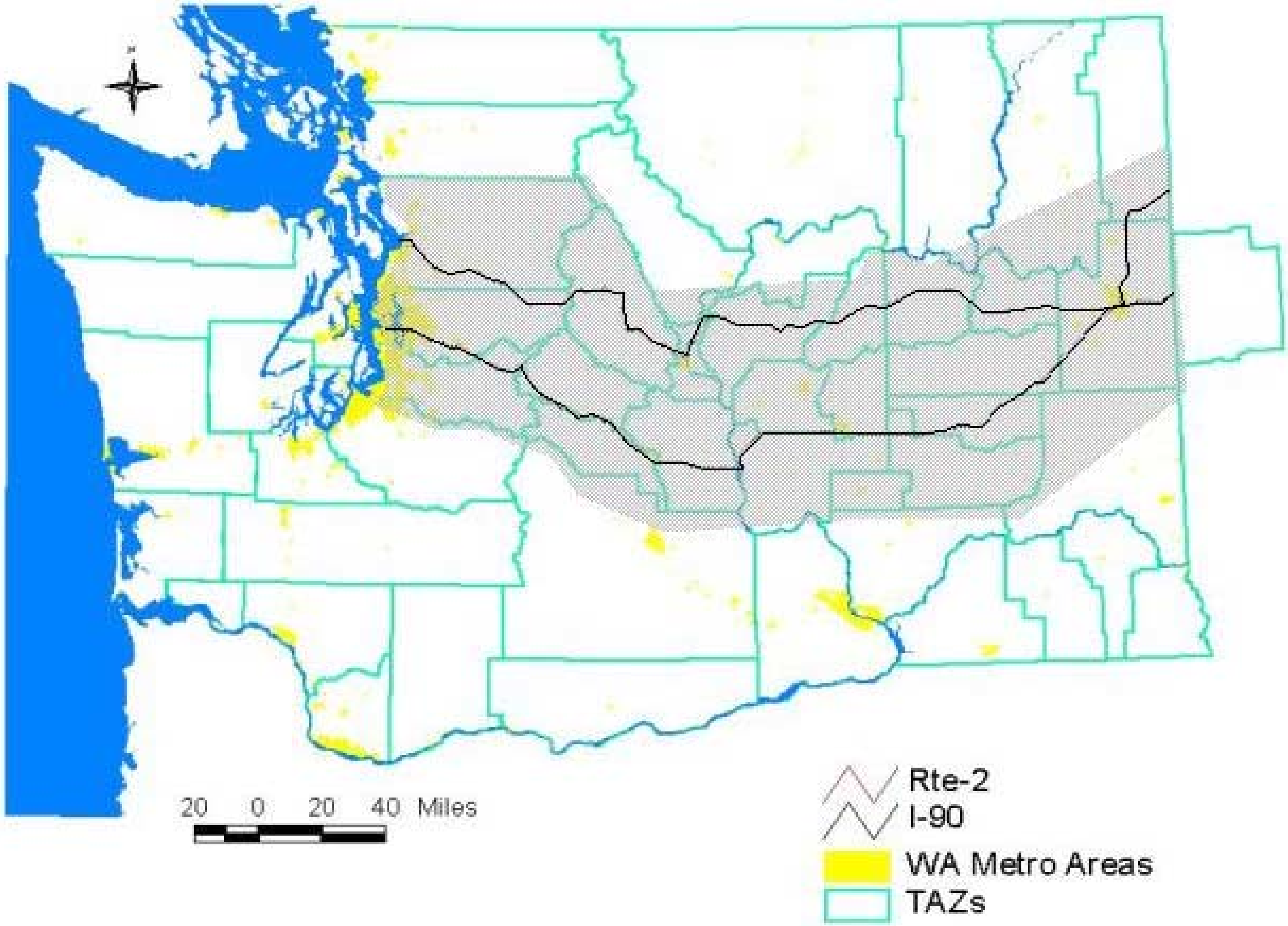
Spokane County was not subdivided. The Puget Sound Region was divided into five zones (3 King, Snohomish County and Pierce County) based on the regional transport network.

External zones were chosen to reflect major travel flows to and from Washington State.

Only the model outputs with respect to the Cross Cascades Corridor itself are considered to be useful in the current application. The other Washington zones are intended to provide a buffer between the external zones and the corridor itself in order to increase the accuracy of flows within the corridor.

Future versions of the model, especially as applied to other corridors should adjust the zonal structure as appropriate for the region under consideration. In addition, with more time for data collection and model specification it may be appropriate to increase the number of zones in a corridor to create more refined estimates of transport flows.

Figure 4 - Cross Cascades Zones



Demographic Inputs by Zone

In the base year, the model was constrained to achieve the official Washington employment and household activity by zone. For future years, no constraint was imposed in the initial runs.

Households by zone
County level 1998 Households were develop from population data by county and household size data from the Washington State Population Survey. County level households were split into smaller sub-county zones using 1990 US Census tract household data. King County was split using PSRC breakdowns.

Total Households by zone were divided into four income groups (described earlier) based on data from the 1990 Census.

In future updates of the model the availability of 2000 census data will improve the ease and accuracy of household estimates by zone.

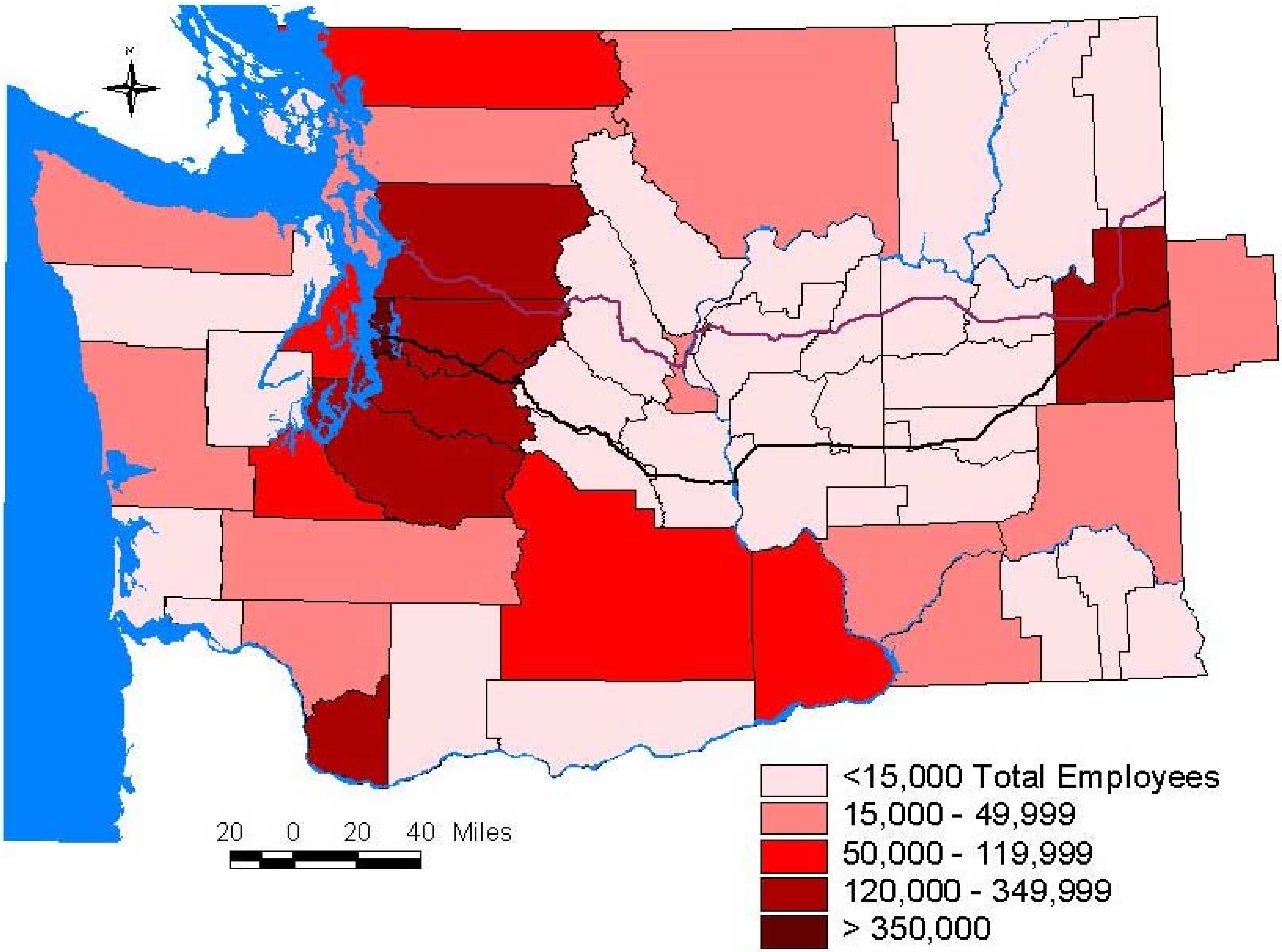
Employment by industry by place of work, by zone
County level 1998 employment by major industry sector were developed from covered employment data and adjusted by industry to reflect total employment. In making the adjustment BEA data on total employment by industry and LMEA studies of covered and non-covered employment were used. The BEA data could not be used directly because it is based on place of residence rather the place of work as required by the MEPLAN model.

As with household data, total employment by industry by county, was allocated to sub-county zones based on 1990 census data. Census Total employment data by place of residence was used. Employment densities by zone are shown in Figure 5.

Baseyear Exogenous Production

In the MEPLAN model exogenous production is defined as that production which is related to export sales or sales to households who's income is not derived from production within the interindustry matrix (i.e., income of retirees, unemployed or investment income). Percentages by industry are shown in Table 1. Exogenous Production by Factor.

Figure 5 - Employment Density by Zone



I-O data processing identified at a statewide level the following WA employees (by industry) and households (by income group) that are working for exogenous production.

Table 1 – Exogenous Production by Factor

Factor	Total	Exogenous	% Exog
Agriculture	122,398	97,432	80%
Mining	3,380	282	8%
Construction	155,869	42,289	27%
Manufacturing	407,455	185,695	46%
TCPU	145,334	59,150	41%
Wholesale Trade	163,227	15,759	10%
Retail Trade	506,920	28,023	6%
FIRE	143,288	47,205	33%
Services	761,001	233,870	31%
Gov't	501,340	229,043	46%
($0-15k)HH Income*	640,496	340,219	53%
($15-30k)HH Income*	544,471	127,394	23%
($30-50k)HH Income*	692,507	84,940	12%
($50+)HH Income*	595,022	54,754	9%
Imports	-	16,160	

In general exogenous production was distributed to zones based on 1990 zone-level counts of "exogenous households" and total employment. Employment data was also reviewed to identify industries within a major industry category that were both predominantly export oriented and highly concentrated in a few zones. Only one case was found in which there was also sufficient data to reallocate exogenous employment. That was in regard to aircraft manufacturing, which is highly concentrate in the Puget Sound area. In this case the amount of employment representing aircraft manufacturing in those zones was automatically assumed to be 95% export. The remaining exogenous employment was then allocated among all zones in proportion to total employment. In future models, the use of more economic sectors in the I-O model, or the collection of more employment data could be used to make a more detailed allocation of exogenous employment.

1.2. The Changes Table

Future Exogenous Production Growth

Future year growth is generated by growth in exogenous demand. The Office of Financial Management (OFM) State-level Covered Employment in Washington State for 2000, 2005, 2010, 2015, 2020 (adjusted by base year non-covered employment ratios) was used to estimate exogenous demand. Spatial allocation of these resulting economic activity is then estimated by the model.

2. Transport Model

2.1 Transport Flows Table

Flow Types

The CCM defines 11 transport flow types (in UTF [1-2]):

- 4 Personal passenger (commuter, shopping, visit friends & relatives, and recreation/other),
- 2 Business passenger (services and business promotion),
- 3 Freight (low, med, high Value to Weight), and
- 2 External truck trip types (external-external, external-internal)

Personal passenger flows are in units of trips per household. Business passenger flows are in units of trips per employee and vary by industry for service and business promotion.

Value to Weight freight categories allow grouping reflective of mode split behavior. These were defined as:

- Low Value/Weight = < $3000 per ton
- Med Value/Weight = $3001-5000 per ton
- High Value/Weight = > $5000 per ton
- External generated truck trips (for which the model does not determine mode split behavior).

2.2 User Modes Table

User Mode Types

The CCM defines 9 user modes in UTF[3]:

- Air freight,
- Rail freight,
- Heavy truck freight,
- Medium truck freight;
- Air passenger,
- Amtrak (rail passenger),
- Coach (bus passenger),
- Private auto, and
- Work auto.

Private and work auto also include van and light trucks for personal and business purposes.

Trucks types are defined consistent with the PSRC FASTruck study (Truck Model Documentation, p.4). The definitions rely primarily on weight, with truck/trailer type classifications added to correlate with Quick Response Freight Manual (CSI, Sept96 for USDOT) categories:

- Light trucks are defined as 4 or more tires, 2 axles and less than 16,000 lbs gross vehicle weight (GVW).
- Medium trucks are defined as single-unit, 6 or more tires, 2-4 axles and up to 52,000 lbs GVW.
- Heavy trucks are defines as double or triple-unit, combinations, of 5 or more axles and over 52,000 lbs GVW.

The medium and heavy categories correlate directly with WSDOT truck traffic counts categories, matching single and double/triple-unit trucks, respectively. WSDOT data groups light trucks with passenger cars.

Mode Choice

In the CCM model mode choice is calculated based on monetary values of time, distance, and cost. This mode split disutility function structure and coefficients are defined in UTF with cost functions in UTF[6], UTM[5], UTX[1]. Costs (disutility) are related to mode choice through a nested logit function with linear utility. The function distributes trips stochastically rather than assigning all trips to the least cost route.

Passenger Cost Functions
Using O-D fare and distance information for coach (Greyhound and Northwest Trailways), rail (Amtrak), and airlines, the following passenger fare cost function were calculated using linear regression. These are shown in Table 2. Other functional forms were also considered, but had a less statistically significant or less intuitive fit.

Table 2 – Passenger Fare Functions

Mode	Terminal Cost	Minimum	Constant	Distance Rate ($/ton-mile)
Coach	NA	$5	$5.53	$0.0874
Amtrak	NA	$5	$5.47	$0.1348
Air Passenger	All	$40	$54.68	$0.0777
	SEA		-$22.51	
	GEG		-$11.32	
	Externals		+$33.88	

For the private drive mode, a distance cost of $0.06 per mile and value of time of $15.00/hour were assumed. Business/work drive mode assumed slightly higher $0.10 per mile and $18.80 per hour. Parking costs at Seattle and Spokane airports were included because of the large rate disparity. Other parking costs should be added for more urban applications of the model.

Freight Cost Functions
Freight costs were assumed to consist of a distance based charge (paid by the shipper to the carrier), a time cost, and a terminal handling fee. A range of distance (per ton-mile) costs were

collected from various sources (NCHRP #388, Port of Portland Study, Horizon air freight). Time cost, were assumed to be:

- $18.80/hour work drive
- $16.50/hour commercial driver

Terminal Handling costs use the distance-based rates and assume a $75 fee for a local (20-mile) Medium Truck trip. This resulted in terminal handling cost of $20.50 for Medium Truck (from Port of Portland Study for containers). The handling cost was increased by 25% for Heavy Trucks. Rail handling fees were calculated assuming that medium truck and rail are competitive at 250 miles (per WSDOT Rail Office). The handling costs used in the CCM are shown in Table 3.

Table 3 - Freight Rate Functions

Mode	Terminal Cost	*Distance Rate ($/ton-mile)* **Range** **(Including terminal costs)**	**Assumed**
Work Drive/Light Truck	$0	$0.04 - $0.10/ton-mile $1.25-2.50/mile	$0.10
Medium Truck	$20.50		$0.08
Heavy Truck	$25.63		$0.10
Rail Freight	$37.50	$0.02 - $0.04/ton-mile $2.20-2.73/mile	$0.03
Air Freight	$70.00	$4.90-7.50/ton-mile	$3.00

2.3 States Table

Travel states and links are used to represent the transport network and apply costs appropriately.

Travel States

MEPLAN refers to travel states as Network Modes, which are defined in UTM [1]. They refer to the various activities that make up the trips defined as mode choices. An intercity bus trip, for instance involves a trip to the terminal, a wait at the terminal the actual bus travel, a wait at the destination terminal and a trip to the actual destination. 15 states (as listed in the Hunt Diagram, Figure 1.) were defined to represent the in transit and station/terminal activities for passengers and freight.

Driving was split into private and work to reflect different values of time. Coach (bus) was split into specific routes/services within corridor and implicit service anywhere outside of the corridor.

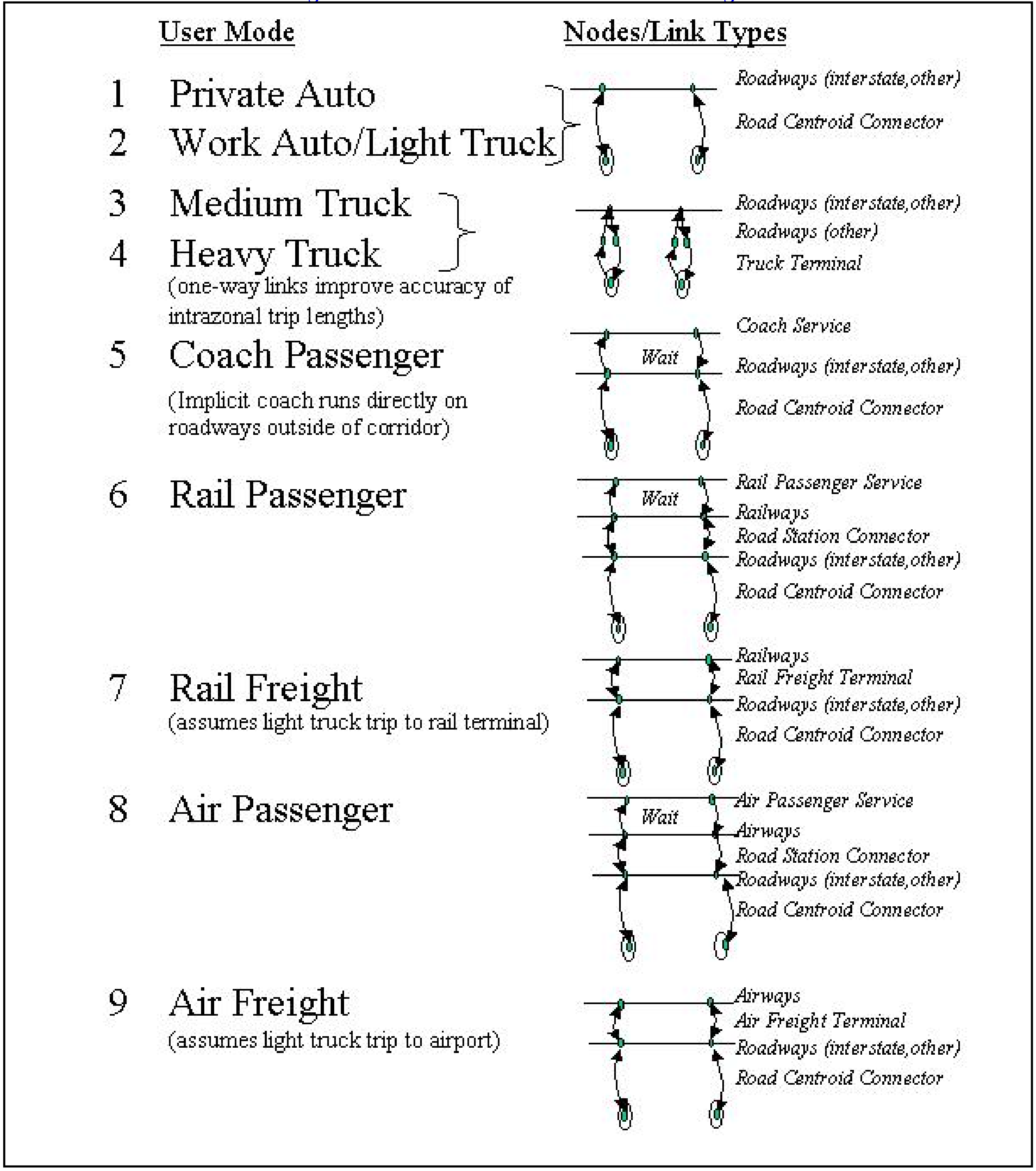
In future model development it may be desirable to distinguish between work and personal trips for rail and air as well. It may also be appropriate to model more completely the terminal and transfer logistics of the freight modes.

2.4 Links Table

Link Types

Links describe how the 15 “States”, or Network Modes connect for any given trip. They are defined in UTM [2]. The links used to connect each user mode to the zone centroids are illustrated in Figure 6, “Centroid Connector Link Design.” In all, 13 link types as listed on the Hunt Diagram (Figure 1.) were defined to represent the process of travel between zones.

Figure 6 - Centroid Connector Link Design



Highways
As discussed in the Land Use Model, the CCM includes the area of the corridor surrounded by zones that include the remainder of Washington and external zones beyond that. Within the corridor itself all state highways are included in the network. The remainder of Washington includes all Highways of Statewide Significance as defined in the Highway System Plan. Highway system nodes were taken from WSDOT's emme/2 model.

Attributes of the highway links were taken from the Travel Delay Methodology, using the following aggregation functions:

- Length (mi) = sum of MP
- Charge ($)= sum of charges ($0 except for ferry tolls)
- Speed (mph) = average speed of aggregated links
- Capacity (veh/hr) = minimum capacity of aggregated links

Special links were created for ferries, international barge link to Tokyo (zone 61), and Columbia river barge. Surrogate costs and speeds were applied to approximate the actual attributes of traversing these links.

In determining the impact of traffic volumes on available highway capacity, the following equivalency factors (Table 4) were used to relate vehicle of different sizes as passenger car equivalents.

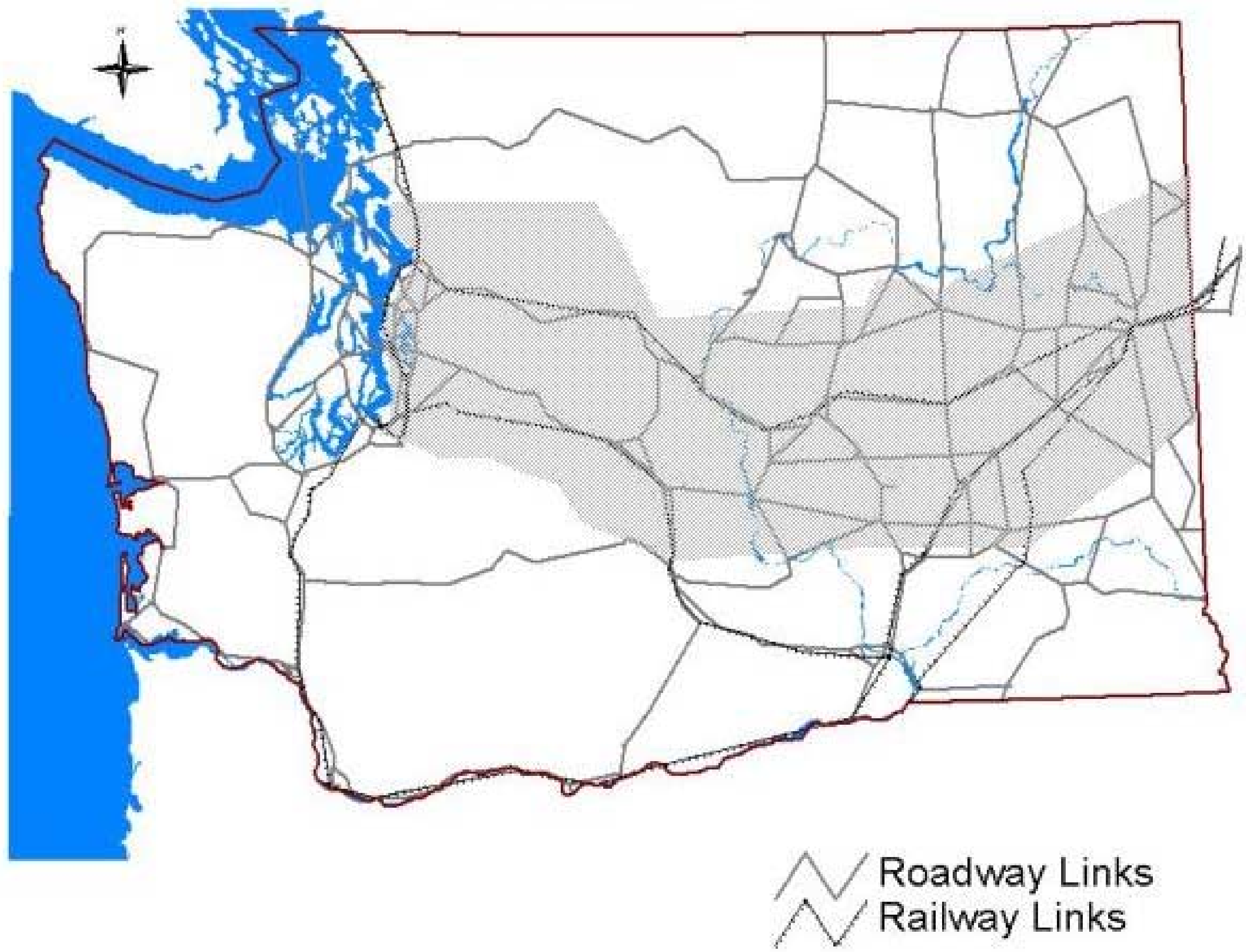
Table 4 – Equivalent Vehicle Ratios

User Mode	Passenger Car Equivalent
Light Truck	1.5
Medium Truck	2.0
Heavy Truck	2.5
Coach Bus	2.5

Railways
The CCM includes all Mainline Class I railroads in WA. Links and nodes were taken from CTA Rail Network. Attributes for freight operations were drawn from various sources and include:

- Length (mi)
- Time (hrs)
- Capacity (gross ton-miles/mile/year)

Figure 7 - Cross Cascades Highway and Rail Network



Airways
CCM includes seven primary corridor freight and/or passenger airports within or adjacent to the cross-cascades corridor, each defined as a separate node:

- Seattle (SEA),
- Spokane (GEG),
- Wenatchee (EAT), passenger only
- Yakima (YKM), passenger only
- Pasco (PSC), passenger only, and
- Boeing Field (BFI), freight only.

Passenger airports are assumed to access external zones if nonstop or non-Seattle one-stop service was provided in 2001. Nonstop service would have the advantage of shorter flight distance and time over connecting service.

Airways are defined as links and include:

- Length (great circle distance in nautical miles)
- Time equal to scheduled passenger flight time

For the airway system capacity is defined at the node. The airway network is shown in Figure 8.

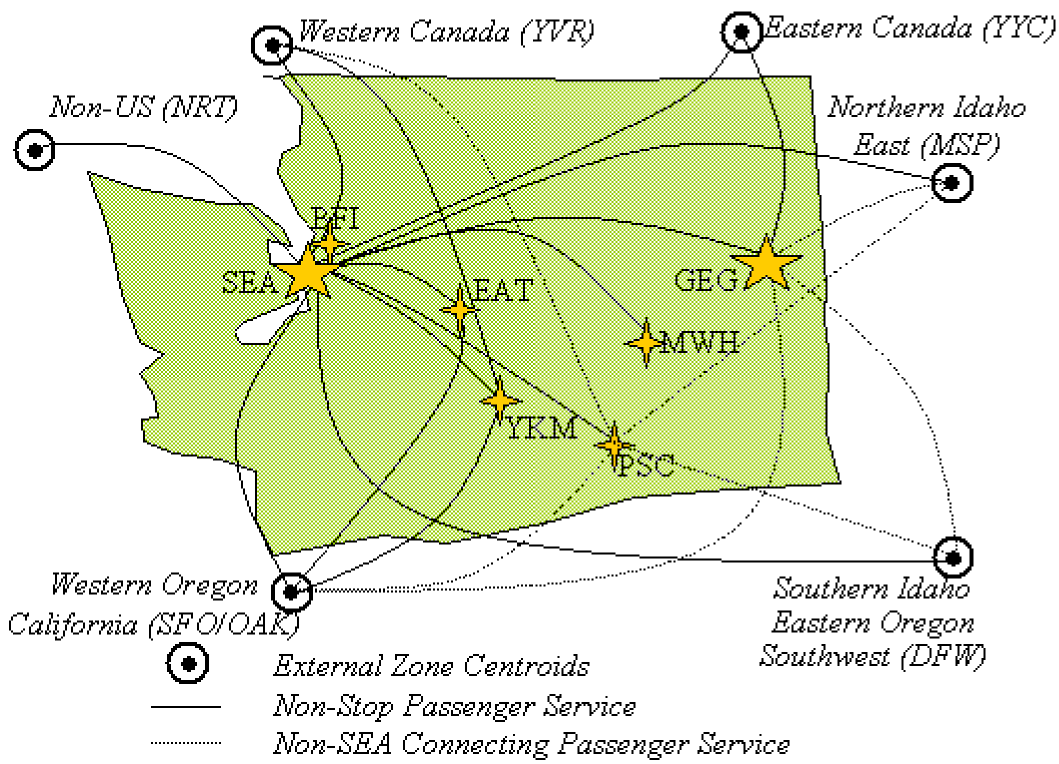


Figure 8 - The Airway Network

Air Passenger Service
Air Passenger service was assumed at all airports except BFI. Attribute data used includes distance, time and speed between stations, aircraft capacity, and service frequencies. The CCM assumes the same external centroid destination for each WA airport origin. If no direct flight exists attributes from non-Sea-Tac were used.

Cities chosen to represent the external zones are shown in Table 5.

Table 5 - Air Services from Cross Cascades Corridor

Zone	City	Non-Stop	WA Origins
56	YVR	Vancouver, BC, Canada	SEA
57	YYC	Calgary, BC, Canada	SEA, GEG
58	MSP	Minneapolis/St.Paul, MN	SEA, GEG
59	DFW	Dallas/Ft. Worth, TX	SEA
60	SFO/ OAK	San Fransico Bay Area,CA	SEA
61	NRT	Tokyo, Japan	SEA

Coach Service (Greyhound & Northwest Trailways)
Public transit network data collected within the Cross Cascades Corridor include station location, distance, time and speed between stations (from published schedules), vehicle capacity, and service frequencies. This initial model included only those schedules within the corridor. Future models may expand to the entire state.

Amtrak Service
Amtrak service from Spokane to Seattle and from Spokane to Portland is included in the model. Attributes include distances, time and speed between stations, train passenger capacity, and service frequencies.

Connectors
Connector links are used to join centroids to the base network and to transfer between modes. They reflect passenger service wait times and parking costs and freight terminal handling charges. Freight terminal handling costs were shown previously in Table 3.

Route/Path Choice

Path Choice function and coefficients are contained in UTF[9]. Cost attributes (previously defined) are found in UTF[4] and UTF[6], while capacity and restraint function are in UTP [1]. The path choice parameters do not need to match the true costs used in the mode choice function found in UTF[7]. Due to limited project scope only highway capacity will be restrained in this model. Actual freight rail travel times (which include congestion) will be used.

3. Interface Model

3.1 Connecting Consuming Factors Table to Transport Flows Table

Trade to Trip ratios

Trade-to-Trip ratios translate economic trades, employee and household units, into transport flows in the form of trips and tons of freight. The rates were developed using primarily NPTS travel data and Reebie freight data. They are input to the model via the UFP file.

Industry –based transport flows:
Trip rates for industry transport flows used Reebie and EWITS freight flow data for through trips combined with Washington employment levels by industry. The following assumptions were made as supported by Table 6.

- SIC commodities 1-9 were produced by Agriculture Forestry and Fishing industry,
- SIC commodities 1-14 were produced by the Mining industry,
- SIC commodities 19-41 were produced by Manufacturing,
- SIC commodities 42-50 were produced by TCPU,
- Wholesale and retail goods production assumed to be 464 tones per employee (the average of the above industries,
- External to internal truck trips assumed to generate 2,116 tons/$1M of Implan imports,
- Through truck tips assumed to generate 322 tons/$1M of Implan imports.

Using these classifications and the combined Reebie/EWITS data for intrastate and internal-external traffic, tons of each value to weight transport flow category were defined for these four industries. These tons were divided by the WA LMEA employment in each industry to generate tons produced per employee.

Table 6 – Freight Trip Rates (1995 US NPTS)

		Ag	Mining	Manfacturing	TCPU
1997 I-E/I-I Tons		**1**	**2**	**3**	**4**
Value/Weight	Low	9,265,423	10,820,524	77,089,686	35,423,068
	Mid	203,008	0	49,939,463	3,877,568
	High	0	0	5,586,221	45,346,426
1998 Employees		122,398	3,380	407,455	145,334
Tons/Employee		77.36	3,201.40	325.45	270.73

Household-based trips
Trip rates for households (commute, shopping, recreation, visiting friends & relatives, services, and business promotion) used 1995 NPTS annual person trips by trip purpose per household. Table 7 shows the trip rates used in the model (based on national averages). For the initial version of the CCM all income categories were assumed to have the same trip rates. This assumption can be changed in future models.

Table 7 – Person Trip Rates (1995 US NPTS)

	Person Trips/HH	
	Annual (1)	**Daily** (2)
Commute	676	2.551
Shopping	775	2.925
Visit Friends and Relatives	314	1.185
Recreation and Other (pop attracted)	983	3.709
Services (3)	1060	4.000
Business Promotion (3)	20	0.075
Total	3828	14.445

(1) Daily = Annual/265
(2) Services = 80% "Work Related Business"
(3) Services/Biz promo assumed 80%-20% split of NTPS "Work Related Business" category, services also includes personal service categories (980 trips) of "Doctor/Dentist" and "Other Family Business."

Commute trips were applied directly as per household trip rates. All other rates were converted to person trips per employee by generating the total number of such trips per employee.

Other Assumptions:

- 10% personal retail activity is shipped/delivered
- 20% business retail activity is shipped/delivered
- Business promotion person trips assumed to be 1% of all business trade
- Construction assumed non-transportable and no business promotion

Load Factors

Load factors refer to tons per vehicle, and passengers per vehicle (auto occupancy) in UTF [4].

Heavy Truck load factors were derived from EWITS and FASTTruck weight classification by commodity combined with Reebie commodities and flow. Light and Medium Truck load factors were derived by assuming an average cargo volume of 100, 60, and 15 cubic yards for Heavy, Medium, and Light trucks, respectively. Truck load factors are shown in Table 8.

Passenger vehicle occupancies were derived from PSRC auto occupancy data and public transit vehicle capacity and load factors. Passenger load factors are shown in Table 9.

Table 8 – Load Factors

User Mode	Flow	Tons/Vehicle
Light Truck	Mid Value/Weight	3.60
	High Value/Weight	3.41
Medium Truck	Low Value/Weight	15.50
	Mid Value/Weight	14.41
	High Value/Weight	13.64
Heavy Truck	Low Value/Weight	25.92
	Mid Value/Weight	24.02
Freight Rail	Low Value/Weight	75.95
	Mid Value/Weight	68.23

Table 9 - Vehicle Occupancies

Transport Flow	Persons/Vehicle	Assumptions
Commute	1.14	PSRC
Shopping	1.42	PSRC
Recreation/Other	1.92	Shopping +0.5
Visiting Friends/Relatives	2.42	Shopping +1.0
Services	1.28	Ave(commute, shopping)
Business Promotion	1.28	Ave(commute, shopping)
Coach Bus	22*	55 seats* 60%LF

3.2 Connecting Transport Flows Table to Consuming Factors Table

A key feature of MEPLAN is the ability of the Transport Model to provide feedback to the land use model (through TAD file). The transport model generates travel disutilities (costs) for each zone pair that in turn influence business and household location decisions. In future year iterations of the model a nested logit model is used to determine the location of business and housing changes in response to these travel costs.

4. Model Targets (Calibration)

After the model has been assembled it must be calibrated to known “target” values. The primary targets to which the model will be calibrated are base year average trip lengths, mode splits and O-D by mode. In this initial model development highway O-D is available only from a synthesized table.

The key data sources for calibration of the CCM are:

- For person Trips
  - 1995 NPTS-WA State trips and trip lengths
  - 1995 ATS - WA State trips (>100 miles) and trip lengths
  - 2000 Horizon Air WA State O-D passenger data
  - WA Airport Activity Statistics for enplaned/deplaned passengers
  - 1999 Amtrak WA State Station on/off passenger data
  - 2000 Greyhound WA State O-D ridership (partial)
  - 2000 Northwest Trailways O-D ridership (selected destinations)

- For freight
  - 1997 Reebie TRANSEARCH O-D flows (tons)
  - 1997 US CFS WA State Internal-External (I-E)/Intrastat (I-I) tons and trip lengths
  - 1995 EWITS Internal-External Truck tons
  - 1996 WA State Freight Rail Study through(E-E)/E-I tons
  - WA Airport Activity Statistics Cargo tonnage enplaned/deplaned

- For network volumes
  - Travel Delay Methodology Highway link AADT (and truck percentage)
  - Synthesized highway O-D from Washington traffic counts
  - 1996 Washington State Freight Rail Study 1996 rail ton-miles/mile by rail segment
  - MPO congested travel time between their external zones (if we have time)

- For future years
  - Washington county-level population.

Minutes of January 19, 2001 Technical Workshop I

To Nancy Boyd

From Sorin Garber

Date January 23, 2001

Subject **Cross Cascades Corridor Analysis Project, Notes from 1/19/01 Workshop**

(Agenda and Attendance List attached)

Workshop Goal – Understand the goals of the Cross Cascades Corridor model in enough detail to select a model approach and prepare a work program identifying those activities that would be necessary to build such a model.

Workshop Accomplishments – In general, participants favored the Spatial Input/Output approach over four other traditional options for building corridor and statewide forecast models.

Notes from the Workshop:

The following notes are provided in the order in which they occurred during the workshop. They are also organized by the presentation slide, in order to provide context for remarks made by participants and presenters were responding to.

Evolution of WSDOT Modeling/Corridor Planning

Todd Carlson noted that LTC policy questions drove initial funding for a statewide model development. When this funding was lost to budget cuts, I-90 corridor study funding was used to fund the Cross-Cascades project. Thus there are two objectives of the project: complete a corridor analysis for I-90; and develop a transferable/expandable model to respond to statewide LTC policy questions. The model should involve all current statewide planning/forecasting efforts, including MPOs and private companies (e.g., BNSF).

Mark Charnews briefed the audience on the foundation of the PSRC model (i.e., it uses an Emme/2 framework for an enhanced 4-step model, etc.). The model is continually updated and an activity-based approach is under consideration. Tara Weidner reviewed the SRTC 4-step model using TModel2 based on a discussion she had with Ed Hayes of the SRTC.

In addition to the PSRC and SRTC models, other models in use in the corridor include: the Wenatchee Area Transportation Study using the TModel2 software (may need an update since the area will become an MPO in year 2002); the Moses Lake urban area uses TModel (needs update); and the Yakima area also uses TModel (which is planning an O-D survey/update). Dave Bushnell reviewed WSDOT's process for estimating future highway volumes and identifying deficiencies. This model employs a trend line analysis of existing PTR traffic counts and incorporates population growth differentials and peak period demands. A discussion ensued on the possible difficulties of a statewide model having to merge different MPO-specific assumptions and socio-economic (e.g., population, employment) forecasts.

Doug Hunt and Tara Weidner reviewed other state's approaches to modeling, ranging from Oregon's Spatial I/0 based approach, the typical 4-Step approaches (used by over 25 states), and trend analysis approaches (similar to WSDOT Travel Delay Methodology). Shuming Yan stated that 'it would be nice to have a land use based model for the Cross Cascades Corridor model, although it may not be possible given the current scope and budget of this project. Faris Al-Memar noted the objective of making use of existing state/regional models, although this statewide model may eventually replace the current WSDOT travel delay methodology functions.

Guiding Principles for Corridor Model Development

Suggestion was made to edit bullet "Integrate output from other models" to "Integrated with other models", which was intended to reflect the need to develop outputs from the model that could enhance MPO models (e.g., external trips, freight).

When asked to rank the bullets in the slide in order of priority, the group began to analyze the principles and defined terms. Though there was no formal voting process and an acknowledgement that the list of principles may have grown into a longer list or simply a different list if the WSDOT project team had had more time to develop them, the project team generally agreed that the first four principles were "absolutely essential" while they were "more flexible" about meeting the criteria embodied in the bottom two principles.

Why we model…

After presentation of this slide, Doug Hunt led the participants through a group exercise where individuals were asked to list the "inputs" and "outputs" they would like to see incorporated into the Cross Cascades Corridor Model. These inputs and outputs were described in the context of "policy levers" and "measures", respectively. Each individual scripted their lists on blue and green post-it notes, with blue indicating an input and green indicating an output and placed them on the screen that projected the slide. During a break, consultant team members organized these inputs and outputs into general categories, as shown in the following pages.

What are the Required Outputs

In response to this slide, there was discussion about whether or not the model should be equipped to prepare output for peak hour or average daily traffic conditions. Faris mentioned that the WSDOT "Travel Delay Methodology is based on average daily volumes." Several participants mentioned that analyzing peak hour conditions is not really relevant for Cross Cascades corridor travel. That is, it's important in the MPO areas, but the MPO models already evaluate peak hour conditions. A suggestion was made that for the external trips into and out of the MPOs, the MPOs can use a temporal distribution factor to translate average daily traffic (ADT) into peak hour trips. The temporal distribution factor can be derived from WSDOT'S permanent traffic recorder (PTR) counts or other methods.

Rob Bernstein asked the WSDOT project team to try to describe the reasons that stakeholders are interested in having a Cross Cascades Corridor model. Faris explained that there are a variety of reasons generally involving a desire to have capability in the department to complete research and assessments of various policies and events. For example, in the Cross Cascades corridor, 1) Regional Administrators believe that

Inputs or "Policy Levers"

Category	**Input**
Interaction with MPOs	Integrate MPO models -- nodes, routes Local/state coordination
Policy Guidelines or Specific Programs	Congestion relief Energy conservation BRCT Recommendations Increased funding for alt. Choices Multimodal decision-making
Road Pricing	Congestion pricing
Road Infrastructure and Connectivity	Freight mobility New infrastructure Changes in network configurations
Other mode Services	Increase AMTRAK service Provide rail cars to shippers
Population and employment	Pop/employment growth Port development Growth management Economic/tourism development Impact of L.U. practices on mobility
ITS	Invest in ITS
Infrastructure maintenance	Current/future practices Inclement weather et al Economic/tourism development

congestion is increasing in rural areas, especially due to weekend recreation travel, and they need a means to understand how bad it's getting; 2) some citizens would like to see a realignment or bypass along SR2, while others would like it to remain as it is; and 3) WSDOT management and staff would like to be able to explore whether improvements along SR 2 or along I-90 would improve overall corridor travel conditions (passenger and goods movement).

As information for consideration of analyzing weekend and special event travel conditions, several participants spoke of the weekend traffic congestion during winter ski season. Dave Bushnell mentioned that his analysis of PTRs indicates weekend travel on segments of I-90 and SR 2 is often 150% higher than weekday travel. The PTRs also provide good seasonal variation factors historically.

Outputs

Category	**Output**
Traffic Volumes (external, by mode/facility, growth, rush hour)	**Freight volume changes** **External-External; External/Internal** **SOV rates** **Train volumes** **Truck VMT** **VMT/capita** **Peak hour**
O-D Demand (by mode, trip purpose, and passenger/freight)	Passenger vs. Freight trips Commodity flows Vehicle mix on highways
System Performance (deficiencies, congestion, etc.)	Identify deficiencies 6 and 20-year forecasts Corridor-wide performance measures Track investment/outcome performance Test proposed solutions
Feed other models (maintenance, safety, AQ, fuel consumption)	Roadway performance Maintenance Safety Fuel consumption AQ benefits/impacts
User and Public Costs	User costs Public costs Geog. Distribution of Econ. Benefits
Travel Delays/Travel Times (reduction, benefit)	Travel time benefits/impacts Travel delay reduction

Potential Approaches – Long Term View

The intent of this discussion was to identify the needs for the Cross Cascades Corridor Model framework, and in particular, the ability for the framework to not limit needs for future analyses (e.g., land use-transportation interactions) the department may want to use the model for. Five approaches[1] to building a Cross Cascades Corridor model that is "transferable" to other corridors, and is "expandable" for statewide modeling purposes and for higher levels of analysis were presented for discussion.

In addition to understanding the long-term analytical merits of one approach versus another, the group discussed the maintenance/update requirements of each approach. This reflected WSDOT's desire to be able to analyze basic policy questions with the model using in-house staff. While acknowledging that modeling travel forecasts is a process of continuous refinement and updating, the group viewed the requirements for updating the Spatial I/O method to be less of a day-to-day requirement than the other methods. However, the Spatial I/O model would require periodic updates and those

[1] The five approaches are; 1) 4-Step process; 2) Spatial Input/Output model; 3) Trip table approach; 4) Microsimulation; and 5) Linear Program model.

might require a significant amount of time and economic expertise to complete. Under this contract's scope, model development would be limited to assembly and borrowing of coefficients from other state models. Calibration/validation efforts would occur in follow-on efforts. Both the 4-Step and Spatial I/O approaches require the same data set for assembly, calibration and validation, except for the need for a State of Washington I/O table in the Spatial I/O method. It was felt that such an I/O table would be readily available from public/private sources.

Key WSDOT WTP outcomes, to be addressed by the model, cited by Faris and Todd, include congestion, freight movement, and economic prosperity. It was felt the Spatial I/O approach would be the only model able to directly address economic prosperity questions.

Possible in Twelve Weeks (a series of five slides)

Led by Doug Hunt, the advantages and disadvantages of each approach were defined and were presented in the context of the feasibility to complete the model development process in twelve weeks, which is what the consultant team has budgeted for completion of this phase of the project. While none of the approaches would result in a comprehensive model at the end of twelve weeks, some approaches would have greater success in producing a meaningful, albeit incomplete, model.

For example, the Microsimluation model approach was dropped from further consideration because of its complexity and the inability for the team to complete a meaningful model in the twelve-week period. The Linear Program model approach was dropped from further consideration because it would require an extensive data collection process and the approach does not have the ability to produce forecasts on its own.

The value of the Trip Table approach was discussed, with some participants focusing on its relative simplicity (no trip generation or distribution) and others concerned about the inability of the Trip Table method expand the model to other corridors, incorporate behavioral responses to congestion, and to provide comprehensive outputs.

A lengthy discussion ensued about the comparative merits of the 4-Step and Spatial I/O model approaches. Advantages associated with the 4-Step method include: it being the traditional method used throughout the state and in other states; its relative simplicity; and the fact that if work had to be halted at any time, that the 4-Step model would produce useful and consistent outputs.

Comparing Spatial I/O and 4-Step Approaches

The group clearly felt that a Spatial I/O model had enormous advantages over the 4-Step model in the long term because ultimately it would be a land-use based model allowing for state-of-the-art analyses of the interactions between land use decision making and actions and resulting transportation behavior. The fact that the Spatial I/O method is driven by economics was felt to be more appropriate than the other methods to answer certain statewide policy questions and would provide a more consistent economic modeling of goods movement. The dynamic nature of the model – where land use actions directly trigger transportation behaviors every three years – had wide appeal to the group. This land use trip generation elasticity (not available in initial 12-16 week development effort) was cited as a reason why the (inelastic) 4-Step methods have historically had difficulty modeling at the statewide level.

Additionally, the Spatial I/O approach was felt to be more useful in MPO-State model integration, since it would differ from the MPO 4-Step framework. A major concern with the Spatial I/O model was that there would be a longer period of time that analysts would need to create the model structure and to test the model operations than there would be with the 4-Step process.

According to Doug Hunt, there was a 50% chance the team would not be able to produce a working population/employment based model using the Spatial I/O approach in twelve weeks, while there would be an 85% of producing an operational 4-Step model in twelve weeks. Doug Hunt asserted that in his experience, with 16 weeks, the consultant team could produce an operational Spatial I/O model based on population and employment that would be capable of being directly upgraded to a land use base once time and resources became available.

Comments to this discussion include:

- Jin Ren, TRPC, advocates the Spatial I/O approach for several reasons. He explained that an important characteristic of the 4-Step method is that it produces impedances that are not relevant to the Cross Cascades Corridor. He felt the Spatial I/O approach would be a more appropriate model for statewide modeling. He said that he's looking for information on productions and attractions in external zones that would allow him to refine the information the Olympia model already uses with outputs that are consistent with the relatively high level of statistical accuracy used in the Olympia model. Jin Ren would like to see the State develop a Spatial I/O model because in the future Olympia will be upgrading its model to a land use/transportation dynamic model.
- Shin Won Kim, RTC, stated that he thinks highly of the Spatial I/O model but he is concerned about the higher risks in developing that kind of model versus a 4-Step or even a Trip table model in a period of twelve weeks. Shin Won stated that unless the State is willing to undergo a 3 to 4 year development program, that he would favor the 4-Step approach. He believes that there are very few experts available to build a Spatial I/O model. Shin Won said that he would incorporate the external zonal information (especially tourism) and freight travel produced by the Cross Cascades Corridor model regardless of the model approach into the RTC model. He felt some of the 4-step model's shortfalls (e.g., land use impact) could be addressed through iterative model applications, post-processing of model output, or reorganization of the order of the 4-steps.
- Mark Charnews, PSRC, stated that it didn't matter to him whether the State developed a 4-Step or a Spatial I/O model because he's only interested in the external trip productions and attractions and either method would improve the accuracy the PSRC model has in understanding these trips. The difference between the output on external trips produced by either model is "negligible" and would represent nothing more than "noise in the PSRC model." Mark agreed that the features of the Spatial I/O approach could address more state-level policy questions, but due to the added risk, WSDOT needs to identify the real need for these features.

4-Step Model Advantages:	4-Step Model Disadvantages:
• A familiar method used throughout the state and in other states. • Relatively simple. • Can produce useful outputs even when it is not completely finished. • Only 15%-20% chance the development of this method will take longer than 12 weeks. • Will be less of a challenge to recruit staff familiar with this type of model.	• Does not produce land-use feedback. • Cannot be expanded into representations of economy. • Does not have land use policy analysis capability. • It is questionable whether this type of model is appropriate for this type of (statewide) analysis.
Spatial I/O Model Advantages:	**Spatial I/O Model Disadvantages:**
• In the long term, would allow for state-of-the-art analyses of the interactions between land use decision-making and actions, and resulting transportation behavior. • Would require less day-to-day updating. • Addresses all outputs required. • Vast opportunity for future expansion. • Can make use of coefficients developed for Oregon. • Output quality will improve with improved (real) data. • Does not duplicate MPO models. • Will provide economic forecasts.	• 50% chance the development of this method will take longer than 12 weeks (up to 16 weeks). • Operation of this model will require a more sophisticated staff (e.g., knowledgeable about economics). • Periodic updates would require a significant amount of time to complete.

- Paula Reeves, WSDOT TDM, was encouraged to see the group considering a model that addresses all modes at a statewide level. She favored the Spatial I/O but felt that the 4-Step process could be improved by changing the order of the steps, as suggested by Shin Won.
- Dave Bushnell, WSDOT TDO, indicated he liked the Spatial I/O approach since he feels the 4-Step methods are pushed beyond their limit in statewide applications. He felt the Spatial I/O method would be better able to address the growth of fringe areas around the urban centers, not covered by the MPOs.

The WSDOT project team discussed whether or not the consultant team would have only twelve weeks to complete this task. Nancy Boyd asked the audience not to make determinations about adding time to the modeling effort at the expense of the later corridor plan development effort because a Chartering session has not been completed for that phase of the project yet. Nancy explained that it would premature to make assertions about how much time is needed for the corridor plan until that session is completed.

Next Steps

The meeting was running out of time and a decision was made not to continue with the prepared slides but to rather summarize the highlights and decisions made in the meeting and to describe the WSDOT project team and consultant team's next steps.

The teams will meet again on Tuesday 1/23/01 to explain the risks and advantages to developing a model in the Spatial I/O architecture. At that time, the team will develop a work program to be presented at the second technical workshop scheduled for 2/2/01. In addition, the consultant team will review whether a portion of the time required to produce the corridor plan phase of the project can be done simultaneously with the model development phase; and if so, whether that would amount to the four weeks additional time that is felt to be necessary to produce an operational Spatial I/O model.

Additional Notes on Spatial I-O Model versus 4-Step Method

Four Step:

Step 1: Trip Generation → Step 2: Distribution → Step 3: Mode Split → Step 4: Assignment

Advantages of this framework were that the steps could be worked on simultaneously. Further, even if the model were not up and running prior to the time the data were needed in the corridor analysis the completed steps and the O&D tables could inform the corridor planning process. Coefficients could be "borrowed" from other models to assemble the model, which could be calibrated later.

Disadvantages are that all forecasts must be outside the model – it is not dynamic. Also, it was acknowledged that without elastic trip generation, for which there is not enough time to develop, the model may not give reliable results.

Spatial I-O

Land Use Component ⇄ **Transport Component**

Land Use Component
- Trip Generation
- Distribution

Transport Component
- Mode Split
- Trip Assignment

The Spatial I-O model uses a land use component to generate and distribute trips and a transport component to generate mode split and trip assignments. The two sides of the model "inform" each other, resulting in a dynamic model. It was pointed out that the model can be constrained to predetermined population and economic forecasts if desired. The fact that the model uses an economic Input-Output table to generate traffic may avoid pitfalls of inelastic trip generation and limited commodity data for freight. As with the 4-step approach, it would be possible to substitute population and employment by zone for a true land use component and to “borrow coefficients” from other models for determining modes split and trip assignments.

A major drawback of this approach is that there are no interim results to inform the planning process if model development takes longer that expected. Also, it will be necessary to buy the MEPLAN model and to train someone in how to use it. (Unlike the 4-step approach with uses models with which many modelers are familiar.)

O&D Tables

It will be necessary to generate O&D tables to run either model. If the models are not fully functional by the time needed for the corridor plan these tables will be of great value anyway.

Attendees:

1.	Sorin Garber	HDR
2.	Doug Hunt	HDR
3.	Tara Weidner	HDR
4.	Mark Ford	HDR
5.	Jolyon Rivoir-Pruszinski	HDR
6.	Rob Bernstein	TranSystems
7.	Todd Carlson	TPO; part of meeting
8.	Bill Osterhout	TPO; part of meeting
9.	Katherine Klockenteger	TPO
10.	Kirk Frederickson	WSDOT Rail Office; part of meeting
11.	Ralph Wilhelmi	TPO; part of meeting
12.	Nancy Boyd	TPO
13.	Faris Al-Memar	TPO
14.	Mark Charnews	PSRC
15.	Shuming Yan	WSDOT Olympic Region; part of meeting
16.	Jin Ren	TRPC
17.	Shinwon Kim	RTC
18.	Paula Reeves	WSDOT TDM Office
19.	Dave Bushnell	WSDOT TDO

Cross-Cascades Corridor Analysis Project
Model Development Workshop #1
January 19, 2001

AGENDA

	Welcome	Nancy Boyd	8:30
I.	Goal for Today's Workshop	Nancy Boyd	8:45
II.	Evolution of WSDOT Modeling/Corridor Planning	Todd Carlson	8:50
III.	Guiding Principles for Corridor Model Development	Sorin Garber	9:00
IV.	Why we model?	Doug Hunt	9:10
V.	What are the Required Outputs	Doug Hunt	9:25
	Break		10:00
VI.	Potential Approaches -- Long Term View	Doug Hunt	10:15
VII.	Possible in Twelve Weeks	Doug Hunt	10:30
VIII.	Possible in Twelve Weeks-Linear Program Model	Sorin Garber	11:45
	Lunch		12:00
IX.	Further Scope Considerations	Doug Hunt	12:30
X.	Borrowing Data from other Models	Doug Hunt	1:15
XI.	What Data do we Want?	Doug Hunt	1:45
	Break		2:30
XII.	Candidate Software Packages	Doug Hunt	2:45
XIII.	Developing the Work Plan	Sorin Garber	3:30
XIV.	Structure and Content of Work Plan	Sorin Garber	4:00

Minutes of February 2, 2001 Technical Workshop II

Cross-Cascades Corridor Analysis Model Development
Notes from Workshop #2
Friday, February 2nd, 2001

Attendees: Ralph Wilhelmi, Todd Carlson, Nancy Boyd, Faris Al-Memar, Bill Osterhout, Gary Westby, Katherine Klockenteger, Steve Smith, Jim Geringer, Dave Bushnell, Shuming Yan, Jin Ren, Miguel Gavino, Shinwon Kim, Sorin Garber, Doug Hunt, Mark Ford, Tara Weidner, Jolyon Rivoir-Pruszinski, Rob Bernstein, Larry Blaine

Workshop Goal – *Definition of a work plan for the development, peer review, and completion of a travel demand forecasting (TDF) model based upon the Spatial Input/Output (I/O) approach using the MEPLAN software package.*

Workshop Accomplishments – *Members of the consultant team outlined the concepts and mechanics behind the MEPLAN model and their relation to the tasks identified in the work plan task list and schedule. Gained input from participants on direction and methods of model development.*

Notes from the Workshop:

Opening Review and Comments

The meeting convened at approximately 9:00 am. Nancy Boyd introduced the members of the consultant team, and invited the meeting attendees introduce themselves and briefly describe their interest and expectations as it relates to the construction of a Spatial I/O TDF model for use in the Cross Cascades Corridor Analysis project. Sorin Garber provided a brief overview of points covered in Workshop #1. Comments of the participants followed. Mark Ford affirmed that by week twelve the need to forecast traffic volumes accurately, employ inputs to effect mode split, and the generation of an O/D matrix, be met. Faris Al-Memar stated that outputs should be identified and needs for performance measurement established as they pertain to the WTP by week twelve. Rob Bernstein suggested that the modeling for Phase II be done as a part of the model testing.

MEPLAN Spatial I/O Software

Doug Hunt presented an overview of TDF modeling using the Spatial I/O approach employing the MEPLAN software package. Doug handed out two papers describing Spatial I/O modeling and the application of MEPLAN in Naples, Italy. Doug described the model as it correlates to the MEPLAN model development work plan task list and schedule (see attached diagrams). Doug pointed out that an I/O table could be provided by a public source, for instance IMPLAN. Miguel Gavino stated that as a result of our time frame it should be determined early on what data sources are available and what details we require. Shuming Yan asked about the model's applicability to US land use planning, which differs from European applications. Doug stated that the less regulated US land use environment would work better, requiring fewer model constraints. For example in Washington, MEPLAN would be able to identify the tax or subsidy required to constrain growth to the OFM county targets.

Task Order AD - Work Program for Model Development:

Deliverables

Tara Weidner opened with the deliverables outlined in the Task Order. Comments by the participants ensued. Faris Al-Memar noted that the documentation of assumptions made in model development, and a "step by step" users manual that supplies instructions on using data inputs/outputs, updates, printing reports, etc. is to be provided, as these items were included as deliverables in the original scope of work. However, the level of detail provided in this manual has not been fully defined. A discussion of potential members of the Peer Review Panel began. Doug Hunt suggested Marcial Echenique, one of the developers of MEPLAN, as a possible candidate. Sorin Garber also suggested Deb Niemeier as a candidate. Other candidates included Steve Smith, WA Department of Revenue (in attendance), Dick Conway, and professors from the University of Washington.

Principles and Objectives

Tara Weidner cited model development principles and objectives as established by WSDOT were as they appear in Task Order AD - Work Program for Model Development. Shinwon Kim suggested that the first bullet of the principles and objectives be modified to reflect "Capable of analyzing and estimating *interregional* demand for highway, rail, and air modes." Nancy requested that all references to the "I-90 corridor" be changed to "Cross-Cascades Corridor."

Phase II Interface – Task List and Schedule:

Tara Weidner addressed steps designed to fulfill principles and objectives of model development and their relation to tasks enumerated in the Phase II work program schedule.

Develop Model Specifications and Purchase Model Software – Task #1

Shinwon Kim stated that he supports that the model be capable of analysis and estimates of regional demand. Miguel Gavino suggested that professional economists become involved at this step. Larry Blaine submitted that assumptions must be documented throughout the model development effort. Doug Hunt stated that model specifications are driven, in large part, by the data available.

Develop Modal Networks – Task #2

Nancy Boyd stated that it is imperative to pin down what data is useful and employ it in the six-week period allowed for data collection and processing. Faris Al-Memar requested that the consultant team convey to WSDOT staff early on as to what type of data is needed, and to what detail, in order to query WSDOT data sources and maximize efforts in the time allowed.

Develop Zonal System – Task #3

Rob Bernstein expressed concern with zone structure interaction and suggested that teams and stakeholders come together to determine zone splits. Larry Blain stated that the determination of zones depends upon which state highway segments we focus our concern. Miguel Gavino recommends contacting sources of economic activity throughout the state (Greyhound, etc.) to aid in zone selection. Doug Hunt suggested using a "county by county" approach in zonal determination.

Doug Hunt expressed concern that the model building team needed to be able to work without fully reviewing each assumption before proceeding. There just isn't enough time. Mark Ford asserted that the consultant team would provide guiding principles in developing the zonal system, but that the team could not review the detailed decisions before proceeding. To address this, it was suggested that WDOT provide one or two persons to work closely with the model development team and participate in day-to-day decision-making.

Build and Estimate Model Components – Task #4 - #8

Tara Weidner briefed the group on the following key model components that will need to be developed by week twelve:

- Assignment and Route Choice Functions
- Mode Split Functions
- Land Use Model
- Trade Trip Conversion Model (converts economic flows to transport flows)
- Exogenous Travel Demand ("through" trips)

Members of the consultant team stated that model inputs must be obtained and processed by week twelve in order to meet requirements for the Phase II element of the project. The team identified the potential need to synthesize highway O-D trip tables from the highway count data using maximum entropy techniques. Larry Blain suggested the team plan to pursue the development of this trip table, regardless of other available data, as an aid to model validation. Miguel asked about time of day. Doug and Tara noted, due to short time frame, that a typical weekday would be modeled with options for applying peak-hour factors. Larry suggested use of a recreation trip overlay on the weekday model, as trucks typically run all week.

Develop and Assess Full Model Interactions – Task #9 - #10

In this step, the range of model components developed in the previous subtask will be assembled, the model fine-tuned and validated. This effort includes the development and assessment of the following:

- Establish consistent interaction for Base Year
- Develop incremental models (3 year steps)

Next Steps
Workshop #3 will convene at six weeks. At this workshop the consultant team will inform the group of what has been accomplished given the data we have. Eight-Nine weeks marks the decision point to review model progress checkpoints in determination of the accomplishments to date. At this point it must be determined, based on model development progress, what data will be used to estimate the model and what can be provided to support Phase II corridor analysis. If there is not enough data available to synthesize an O/D table, an alternate O/D trip table for various modes must be developed. After a brief discussion it was decided that the consultant team would generate the alternate highway O/D table regardless because it would be a good comparison to the output of the MEPLAN model, regardless of timing.

Miguel raised an issue of whether someone from WSDOT should work directly with the consultant team in order to be available for decisions on detailed assumptions and to assure that WSDOT fully understood the model when completed. Faris and Nancy agreed to discuss this further after the meeting.

Attachments:

- Model Development Work Program text
- MEPLAN diagrams
- “Calibrating the Naples Land-Use and Transport Model” (available by request)
- “Theory and Application of an Integrated Land-Use and Transport Modeling Framework” (available by request)

Minutes of March 16, 2001 Technical Workshop III

Cross-Cascades Corridor Analysis Model Development
Notes from Workshop #3

Friday, March 16,2001
WSDOT Eastern Region Engineer's building – Spokane County Room

Attendees: Todd Carlson, WSDOT; Miguel Gavino, WSDOT; Larry Blain, PSRC; John Abraham, University of Calgary; Tara Weidner, HDR; Ed Hayes, Spokane Regional Transportation Council (SRTC); Shannon Amidon, SRTC; Jolyon Rivior-Pruszinski, HDR; Shinwon Kim, SW Washington Regional Transportation Council (RTC); Bill Osterhout, WSDOT; Jim Geringer, WSDOT; Rob Bernstein, TranSystems; Jin Ren, Capital Regional Council; Mark Ford, HDR; Nancy Boyd, WSDOT; Sorin Garber, HDR; Roger Johnson, HDR.

Workshop Goal – To provide a progress report on the modeling development process and approach, data sources, and assumptions used for model specification, zones, and networks. In addition, the meeting was intended to identify potential future model upgrades that could be coded into the next generation of the model development process.

Workshop Accomplishments – Team members reviewed progress and assumptions and provided input to present and future model development.

<u>Notes from the Workshop</u>:

Introduction

Sorin opened the workshop by reviewing the purpose of the meeting and the decision processes that led to the development of the spatial input-output modeling approach.

Progress to Date

Mark reviewed progress to date from the attached flow chart. He pointed out that model development is in week six of a sixteen-week process. Specification is almost complete and data collection is progressing. The primary item on the critical path is incorporation of the input-output model into MEPLAN, the model software. While there has been a visible flurry of activity the past few weeks to construct the model framework and collect and review data sources, the next weeks will appear relatively quiet as data is entered and initial model runs made. The team expects to have data that will begin to inform the Phase II stage of the project starting in week 12. The next formal progress meeting will be June 1st, when the Peer Review meeting takes place. (Later in the meeting it was determined that another meeting will take place at the HDR Portland offices soon after initial model runs are completed.)

Nancy discussed issues of obtaining the MEPLAN software. The company that produces the software has given permission to WSDOT for the team to use the software licensed to the University of Calgary in order to allow the project to proceed. They have not decided what type of license to sell to WSDOT or what response they will give to Nancy's inquiries about making the software available to MPOs in Washington. WSDOT will not require use of the model by regional governments, but wants to have it available if they wish to use it.

There was discussion of the need to open up the June training session to others besides WSDOT staff, including MPO representatives and interested university students. Having WSDOT staff on the model development team should facilitate transfer of the CCC MEPLAN model to WSDOT staff.

Model Specification

John and Tara lead a discussion of model specifications using the "Hunt Diagram."

There was considerable discussion of how the Washington State input-output (I-O) table was to be incorporated into the model. The I-O data will describe economic relationships at a statewide level that will be applied to the base year employment and households of each zone. Because the purpose of the MEPLAN model is to determine transportation demand, there are some adjustments not normally used in I-O analysis. Moreover, because the model is dynamic the exogenous inputs (exports, retired, unemployed) in the base year are calculated by the model for future years, given statewide exogenous growth rate inputs. State-level exogenous factors will be distributed among the individual zones. Within MEPLAN, exogenous is defined as outside the Washington State economy, in contrast to the transportation planning/modeling terminology of exogenous as outside of the study region.

Household income is an important determination of travel behavior in this model. Income groups need to be defined the same way across the state. Income groups will be derived and defined from 1990 census data.

There was discussion about the use of local forecasts in the interregional model. The model's forecasts should be consistent with those used in local comprehensive plans. The model can be constrained to specific forecasts if desired. However, the initial runs will be unconstrained. After evaluation of the initial runs the team will decide on what if any constraints should be introduced.

John discussed how links, nodes, connectors, travel times and wait times are all used in the model. For example, a rail passenger trip consists of a road connection to the station, a wait at the station to access the Amtrak service, travel to the destination station, transfer from the service to the railway station, and a road trip to the destination. The logit mode split model considers the entire trip time and cost in evaluating the alternatives (including congestion). Route assignment is based on a logit model that provides a multipath/stochastic assignment, not a single choice of route. Larry requested that non-auto access be enabled to air and rail services.

A question was raised about how telecommunication/internet technology (ITS) is affecting transportation demand. The model (i.e. trip rates per employee) could be adjusted to reflect assumed technological change. This is one factor that should be added to the list of considerations for the next stage of development of the model, as there would not be time to include it in this analysis.

Travel reliability was also an issue for which the model is not specifically set up to accommodate, but could be considered in future updates. This measure could be added as an input factor ascribed to each link and included in the mode disutility. Alternately reliability could be an output performance measure. Future efforts would need to define reliability (e.g. duration, frequency) as well as expected behavioral response (e.g. elasticity to changes in reliability). Ed mentioned that reliability is considered monetarily as part of the margin by shippers when making mode/route choice decisions.

There was also discussion of freight data being used in the model development process. A combination of data sources (Reebie Associates and EWITS) is being used to get the base year inputs. Todd requested that the team point out areas where improved data sources would be of use in future modeling. Miguel pointed out that EWITS will be advancing into another phase, and believes that suggestions about how to improve the EWITS database would be welcomed.

The base year for the model will be 1998. Travel patterns will be described in average weekday terms.

Later in the day there was a discussion of what scenarios will be run with the model. The present plan is to run a future baseline that includes projects already in the program, a “complete the Highway Plan” option, and at least one other option. The composition of these scenarios needs to be clarified.

Analysis Zones

Jolyon discussed the zone divisions for the model. Within the corridor itself, counties are subdivided. Other counties within Washington, but outside the corridor, are included as single zones. King County is divided into three zones and Spokane County is kept as one zone. Kootnai County, Idaho is treated as a Washington zone for the purposes of this study. Beyond the Washington State borders there are six external zones -- two in Canada, two in Oregon, one for overseas markets (except Canada), and one for areas east of Idaho.

Economic Data

Mark reviewed the economic data to be used in assembling the model. Three sources were reviewed:

- Employment data from the Office of Employment Security, Labor Market and Economic Analysis (LMEA);
- Population and household size data from the Office of Forecast Council; and
- Input-output data from the IMPLAN I-O Model.

The model uses households by place of residence and employment by place of work. The I-O model relates activities in each sector to that of other sectors, and relates exogenous demands to local impacts. The I-O data entered into MEPLAN consist of technical coefficients based on employees and households rather than the dollar based technical coefficients typically part of I-O table data. The MEPLAN coefficients better represent the social interaction of employees and household trips generated from the I-O dollar flows. Although the OFC has historically developed Washington State I-O tables, the latest table was from 1987, so the 1998 IMPLAN format was preferred. It was suggested that the OFC be involved in future efforts to process I-O data for MEPLAN.

Again, it was noted that the model produces its own forecasts, but that it is important to relate these forecasts to those of regional and local plans. Both SRTC and PSRC offered to provide their base and forecast data. LMEA employment and OFC population also provide forecasts to be used as model targets in future years.

Networks

Jolyon and Tara reviewed the networks being set up for the model. As noted above, external connections will be renamed to refer to the zone rather than the "centroid". Rail attribute data is weak. Larry offered data for I-5 corridor in the PSRC region. Todd said that Patti Otley at BNSF is also willing to support our modeling effort. It was suggested that air links to external zones be adjusted to accurately account for connections made in Spokane vs. Seattle airports.

Todd suggested that Port traffic be linked to external zones, so port competition/usage could be modeled. It was suggested that future efforts could include HOV and HOT lanes. These could easily be accommodated in the model, by building the appropriate network links with associated attributes (e.g. tolls, access restrictions).

On airways maps it was noted that some of the terminology is confusing because the external zones are named by centroid instead of geographic region. The team will make appropriate changes.

There was a suggestion that a separate zone be placed at certain recreational sites, especially at ski areas, which attract people that do not complete the link but return the same direction they came. This would involve readjusting existing zones and will be an option for future efforts.

Rob and Tara discussed the relationship of the two largest metropolitan areas to the Cross Cascades Corridor. It is necessary for the Cross Cascades model to specify a simple network and allow for some congestion in each of these areas, but more detailed analysis should rely on the output of the regional models rather than the Cross Cascades model for travel times and volumes.

Ed suggested that the resulting rail network identified in the "Bridging the Valley" study could be a test evaluation for the Cross Cascades Corridor model.

There was a discussion of how densely the CCC network needs to be specified within metropolitan areas. The conclusion was that it is about right as currently defined. In King County it is important that the CCC model correctly reflect zone-to-zone travel times that are equivalent to those produced by the PSRC model.

Focus to date has been on establishing the base year network. Future committed baseline changes (e.g. network and service improvements) will need to be identified. Nancy indicated that the WTP process has developed a list of planned improvements, and Ed indicated that airports should be contacted regarding planned capacity improvements. The team will get back to the Workshop participants to review the assumed baseline changes.

Visual Output

John gave a presentation on his laptop of some of the visual output that can be generated by the MEPLAN model, based on a previous MEPLAN evaluation of the Sacramento, CA urban area. Several of his slides related to land use questions, which are beyond the model currently being constructed because it does not include the land use link of square feet needed by industry. Other slides, more relevant for the CCC study, related traffic volumes and mode splits. Participants were asked to think about what visual outputs would be most valuable. An e-mail survey will be sent out to workshop participants to gather their input.

The graphical system to be used will be ARC View. MEPLAN's built-in interface is to MapInfo. MapInfo is not readily useable by WSDOT, so WSDOT has directed the team to produce a one-way ARC View visualization of the MEPLAN data.

Roundtable Recap

The recap began with a review by presenters of the comments they heard from workshop participants (which have been incorporated into the individual sections).

Each participant was then asked to provide their closing comments and observations – beginning with MPO representatives.

<u>MPO Comments</u>

- Should use employment and population data from MPOs. Consistency is important.
- When we have a MEPLAN user meeting/training session we might invite UW and WSU students as well.
- Should consider including Columbia River barge traffic as well as other freight modes.
- Flexibility to include more options is important. (e.g., Bridging the Valley rail network).

- Concern that most of the applications we have seen for this type of model are urban, but this is a statewide, mostly rural application.
- Need to understand more clearly how link-delay methodology works. Won't understand until we see some outputs and route assignments.
- This model links better to the Governor's four principles for development.
- Freight links are very important.
- Can't visualize the model fitting into the Olympia region, where the government/service economy is largely driven by exogenous factors.. May not replace existing urban models.

Other comments

- Need good documentation.
- Need to think about what things will be needed to make this model better in the future.
- Could we build in travel reliability?
- Could we build in impacts like HOV/HOT lanes and/or telecommunications?
- Aging population will be a concern. Could this model account for that?

Next Steps

- HDR will send out an e-mail survey out visual outputs and other issues.
- When initial model runs are complete HDR will invite the project team and attendees to a special meeting at the HDR Portland Office (expect in about six weeks).
- The June 1 peer review meeting will be the next formal workshop, tentatively scheduled to be held at SEA-TAC airport

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Minutes of May 4, 2001 Technical Workshop IV

Cross-Cascades Corridor Analysis Model Development
Notes from Workshop #4

Friday, May 4,2001
HDR, Inc. Portland Office

Attendees: Clara Fabre, WSDOT-NW Region; Faris Al-Memar, WSDOT; Miguel Gavino, WSDOT; Larry Blain, PSRC; John Abraham, University of Calgary; Tara Weidner, HDR; Ed Hayes, Spokane Regional Transportation Council (SRTC); Shannon Amidon, SRTC; Bill Bennett, WSDOT Eastern Region; Jolyon Rivior-Pruszinski, HDR; Shinwon Kim, SW Washington Regional Transportation Council (RTC); Bill Osterhout, WSDOT; Jim Geringer, WSDOT; Rob Bernstein, TranSystems; Jin Ren, Capital Regional Council; Mark Ford, HDR; Nancy Boyd, WSDOT; Sorin Garber, HDR;

RE: CCC Technical Workshop IV -- Notes and Requests for Information

<u>Notes</u>

- Participants felt comfortable with the model components that were reviewed (input focus) and got a better understanding of how the model works. There is a strong interest in further review of model outputs/calibration (e.g. Peer review).
- Questions about calibration process including intrazonal trips, validation of future year outputs, and model sensitivities. Documentation of the calibration data sets and an overview of how to calibrate the MEPLAN model were requested by Larry.
- Ed Hayes -- Time of day is significant for Amtrak vs. intercity buses because intercity bus leaves and arrives during daylight hours, while Amtrak is in the middle of the night. Amtrak also has reliability problems. John said that you could handle that by adding more delay to make Amtrak less desirable. Ed offered to try and get O-D information and schedule adherence information from Amtrak.
- Larry said we should rely on the MPO models for reliability in their areas (e.g. congested travel time through metro areas, parking costs); congestion isn't really an issue outside the MPOs, so reliability related to congestion shouldn't be given too much attention.
- Larry said PSRC assumes a daily traffic figure of 12 hours/day (CCC currently using 10 hours/day). Could also look at TTI report for VMT/lane mile
- Without rail capacity restrictions, it will be important in this study to explicitly define future networks and mode cost structures, as well as identify the need to add rail capacity.
- US NPTS trip rates were acceptable, although other sources mentioned include NPTS by income quartile (Larry will look into), and Oregon survey data.
- Shinwon had concerns about how dynamic the land use model is. He will send an email to the group documenting this issue.
- Miguel expressed concerned about the ability of WSDOT to make use of the model in-house.
- During the roundtable at the end of the day the following points were raised:
    - Most were comfortable with what they have see thus far;
    - Concern over transferability of the model to MPOs (Jin Rin)

- Need to see calibration – important to document recalibrations (Larry)
- Need to see results, particularly future
- Concern about next steps, particularly with the short time remaining.
- Would like to have another workshop – maybe connected to the peer review or the training.

Requests for information

- Larry wants a copy of the IMPLAN spreadsheet(s)
- Faris suggested we send spreadsheets to the attendees to review our assumptions - particularly about factors used in the trip tables.

Other

- Need to update titles in LUSA tables to say Cross Cascades instead of Sacramento